Bottesini's Silk Strings

Myth of the Past or String of the Future?

Introduction

It has been a long-standing idea in the double bass community that Bottesini performed on silk strings. The impetus behind this statement comes from a publication by Rodney Slatford - *The Complete Bottesini* (*1*) - and seems to be the only source from which this claim originates.

The purpose of this article is to give an account of what I discovered and what opinions developed over the course of the experiment using the resources I had at my disposal. As with all research, it is not always possible to give a black and white answer or an exact solution to a 'problem'; however I felt that the more information available to the double bass community, the more encouragement there might be for others to also research. In Bottesini's own words, "*I hasten to forewarn those who might accuse me of a certain exclusiveness, more apparent than real, that I have every respect for the opinion of others, whilst I frankly state my own."* (*2*) My aim is to try and create positive dialogue on the subject and to find if others have come to similar conclusions in their research, all adding to the melting pot of resources for bassists.

Until recently, Rodney Slatford's quote in his publication the *Complete Bottesini* has been left as a relatively unanswered or unchallenged statement. I have often wondered what were the realities of making this statement work and have pondered why it hasn't been commonplace (at least amongst period performers today) to find bass players using silk strings. With this unanswered question I started my research into the reality of Bottesini using silk strings. It is worth mentioning however that the ambition behind this research is to look at the likelihood and practicalities of Bottesini using silk strings in his performances rather than the history of silk strings in general.

Having said that, to give some context, it has been known that silk has been used as a material for strings for centuries, with records in Europe from the middle ages (*3*) and one record in Italy as early as 1640 by Giambattista Doni (*4*). In Persia silk is documented being used on instruments as far back as 1355 (or 1363 depending on the source) (*5*). China and its surrounding countries have been using silk strings in some fashion for at least 4000 years according to Alexander Raykov (*6*).

Another aim of this article is to revisit this subject in more detail than the short article I posted on social media in 2020. Since this first look into the subject I have found more information, giving me greater insight, and the period of time has given me more chance to consider further facets to the project.

So where to begin a project like this? As with all research it's a voyage of discovery and it can be difficult having the 'blank page syndrome' at the start, however the main focus of the project was to try the strings for myself and see first hand how they work. For me this was the only way to get a clearer answer on the likelihood of Bottesini having used them in performance. It is easy to hypothesise what his strings *might* have been like; moreover it is

also easy to use silk strings as a hypothesis to the number of complimentary articles Bottesini received for his playing in his lifetime, or as a form of justification to why he was so different from all the other bassists of his period. For me however, it came down to his extraordinary ability and hard work rather than the strings he used. All of the statements above have been untested and hypothesised and I felt that the only way to answer this was to try silk itself.

Variables

It is worth noting at this point that there are some variables that I cannot account for in my work, due to these being either out of my control or not having access to certain resources, however I felt that the results of the research were governed by the properties of silk as a material rather than being dictated by these variables.

The variables I have considered are:

1. I do not have access to Bottesini's bass to try these strings on.
2. I do not have access to Bottesini's bow to understand how his equipment would have responded to the string. Nor do I have access to another French (pattern) bow made during the period that Bottesini was alive to test its possible weighting, and in turn, how a bow made in Bottesini's time behaves with the string. Bottesini however was one of the strongest influences for the uses of the French pattern bow and certainly contributed to its development. Photographs of his bow do not look too dissimilar to the modern bow, having both a concave 'tourte' curve and a similar head shape (aside from one photo) and hair tensioned by a frog on a screw thread.
3. I tried both wooden and carbon fibre bows, but mostly used my carbon fibre bow when researching due to the feeling of the string releasing microfibers disintegrating from the string into the bow hair, and I didn't want to cause issues with my main playing bow.
4. Rosin today is different from that of Bottesini's time.
5. The over-stand of the neck - I have tried both a bass from Bottesini's period, a bass made in the Vienna region (around 1820) with an original over-stand for gut strings and its original neck, alongside a modern bass with a modern over-stand and found that this did not affect the results of my research.
6. Looking at photos of Bottesini's bass, it looks like his bridge is very similar or (possibly) the same as we use today, but without seeing in detail what it looks like this cannot be guaranteed.
7. Bow strokes or styles - my playing is influenced by a modern school of bowing, due to the fact that I did not study in Bottesini's time. This could potentially mean I have tried bow strokes that were not commonly used in Bottesini's time; however, I have tried to keep the strokes as simple and 'universal' as possible. We do however have access (thanks to republication) to Bottesini's Method, which has bowings written inside it, often favouring 'retakes' of the bow as compared to more modern styles.
8. Modern luthier's techniques with regards to the choice of sound post positioning or depth of curve in the fingerboard are variables I cannot account for, as the data for when Bottesini was using his bass is unavailable.
9. The construction of the silk strings tested was made in the same fashion as those of Baud, who made silk strings in the time of Bottesini.

I would like to take a moment to reiterate that I did not feel the above variables would drastically change the results of my findings or impact my results in a way that would render them completely useless or uninteresting to others. I feel the biggest impact on the results for this research were the properties of silk itself and how it behaves when scaled to the string length of the double bass. I also thought out of the list above that silk strings were probably one of the least written about subjects and so it was important for me to try and create some resources for others to use. Also, other areas listed above have been written about in articles on the construction of instruments, or in other researchers' discoveries in historical performance. I accept there have been developments in instruments since Bottesini's time, but I do not feel these are drastic when compared with the bass of earlier periods such as violones or gambas, and by the fact that Bottesini tuned his bass in fourths as commonly found on the bass today. I felt there are more points shared by the instruments of today with Bottesini's bass than that would have been used in a orchestra of Mozart and Haydn, and so playing a silk string on an instrument I own would provide some useful information for others.

Preliminary Research

Before writing the first article, these were the initial steps I took to start my research. As the ambition was to try silk strings myself, the first (and quite large) hurdle was to find a string manufacturer that could produce silk strings for the double bass. After much searching on the Internet, I came across (by chance) the maker Lawrence Kaster (*7*) who manufactures strings made from different materials, most notably silk. Lawrence has been making various types of strings for many years and it was thanks to his experience and manufacture that I was able to conduct this research.

Alongside the initial search to find a manufacturer for the silk strings, I engaged in research to try and find sources proving that Bottesini's strings were silk. Unfortunately Rodney Slatford's '*Editors note'* (*1*) is unreferenced and provides no citation as to where he found the information. This unfortunately is a big stumbling block for a very detailed statement and one that has implications on the entire sound or playing career of Bottesini. Also, for any musician looking into historical performance, it leaves researchers with no place to start their research. Over the last few years I have been studying Giovanni Bottesini's life, collating information and materials to promote research into his life by the means of republication of books, articles and resources relating to Bottesini. It is within these items I started my search for answers. My first starting place was to look at Giovanni Bottesini's Method (*2*) for double bass, in which Bottesini mentions strings within the publication:
"*By using three plain strings we avoid the great inconvenience of two wire covered strings which by the very nature of their heterogeneous envelope allow of less pressure, and present more difficulties to the attack of the bow."* (*2*)

After reading the statement in Rodney Slatford's publication (*1*) and what I had read in Bottesini's Method, I developed some preconceived ideas on how I thought a plain silk string would behave. Bottesini himself was a bit of an enigma, his playing being so different from others that audiences were always in awe of it, and to quote queen victoria, "producing sounds never heard before". (*8*)

I thought to myself that there must have been reasoning behind this; one of them must be due to the statement of Bottesini using silk strings. My thoughts were that the strings must

have responded in a way that made his pieces easier to play, making his harmonics ring out as clear (if not better) as we are used to today on steel, and that it must have given him a timbral advantage, allowing him to stand out from all other players. I was hoping that this must have been the 'secret' to his playing.

If this was the key to his playing I wondered why this wasn't commonplace today and that hopefully I was stumbling upon something that could be a revelation for the bass community. I was hoping that it would be a discovery that would be of benefit to others, and that it would provide a solution for a more sustainable string. At current, strings are not widely recycled and are not always made of materials that could be recycled. Gut of course relies on taking animals' lives and is unpleasant to make. I therefore hoped that looking into this material in the past would provide a solution for the strings of the future, being sustainable, environmentally friendly, and biodegradable.

With the internet being the starting point for most people's research today, I also set out searching the World Wide Web looking for answers. Immediately I could see this was going to be a struggle for information, my initial searches providing very little. One gem of knowledge I came across was the research of Maestro Korneel LeCompte, whose findings I will discuss in a later section. Korneel LeCompte's website apart, I came up against a brick wall, finding no other resources immediately to hand. The few one line references I found relating to Bottesini using silk strings all led back to Rodney Slatford's statement in his publication, with no further information than 'he used silk strings', with no reasoning as to why, when or how. Any information or publication I found simply repeated without question what has been written from Mr Slatford's publication.

Faced with this difficulty, the only thing left to do was to try the strings themselves and report on the findings. My aim was to see how the string compares to both gut and a modern string (Evah Perazzi) and collect this evidence into this document in order to help other people's research. The experiences and information I have put together can be found in the pages below.

My Findings

Once my strings had been made and arrived, I was quick to dive into playing them, hoping to discover a whole new sound world, something to revolutionise my playing and to give insight into Bottesini's playing. Below, divided into relevant sections, are the findings and opinions expressing my experience of trying plain silk strings on a double bass. I presumed that silk would sit somewhere between gut and modern strings of today. I was hoping this would give explanation as to why Bottesini's sound was so adored by many and that it would explain why he was able to compose and perform pieces with such clarity. It became very apparent to me (immediately) how markedly differently silk responds as compared to both gut and steel, and my results are found below.

Immediate/Initial findings

My initial hopes that silk was going to respond better than gut evaporated instantly. Immediately it became apparent that the string had very opposing properties, responding in a Jekyll and Hyde fashion, sounding fantastic for pizzicato and very unpleasant bowed. When bowing I was presented with what can only be described to my ears as a sound that was shrill and unwelcoming. Perpetual squeaks and unwanted noises continually emit from the string when used under the bow and require constant concentration to avoid, allowing

no brain space to consider dynamics, phrasing, or any other musical points, acting as a hindrance.

Overall, silk's timbre is similar to that of gut when compared to modern steel strings, having a similar initial bite to the sound when bowed; but generally the sound is not as warm or agreeable. The sound has more treble and brighter frequencies to its composition with far more higher overtones being heard rather than the fundamental, giving it a 'springy' sound.

Pizzicato

Pizzicato, however, was a sound I actually preferred to gut, for me having a more pleasant tone and fantastic response for jazz - silk strings I would happily mix into a band. It also seemed to work well when trying a bit of 'rockabilly' slap bass, however I would need to try this on a few concerts to see if the string could handle the repeated stress of being pulled. The feeling of the string being plucked under the finger however was very similar to gut due to the lower tension and the thickness of string. Similarly, as mentioned above, other overtones ring out, giving it that springy sound synonymous with gut. The most recent string that it compares to is that of the 'velvet' (a product name rather than the material) strings which had desirable pizzicato sound, but were difficult to bow.

As the most common use for a double bass in Bottesini's time would have been bowed, I have focused my findings around this. I have detailed further I problems found in the sections below.

Speed of response

One of the first things to become apparent is the speed at which the string speaks. The response is very slow, what feels to be about a third slower than gut, meaning that the ability to play off the string, or fast passages (Bottesini's Capriccio di Bravura for example) become impossible to play as the string is simply not ready to meet the demands of the quick change of bow. This means that writing for these strings would be far more limited to longer and slow notes rather than what appeared in Bottesini's compositions, as repeated semiquavers become an issue. Another issue that presents itself is the limited area in which you can bow in order to match the slow response of the string. You are left with a small region about 40mm up from the bridge, which is the area where the string responds, making it very limiting for variations of sound with a piano dynamic or flautando becoming difficult to execute. The way in which the string speaks also presents an issue with harmonics, which is mentioned further on.

String tension/density

My findings regarding tension are that silk, surprisingly, has a fantastic ability to take tension. I felt, due to its construction, that it could be pushed quite far before it would snap, meaning that it did have a potential tension advantage over gut, sitting somewhere between steel and gut. The first string I tried, however, was too low tension for its pitch and thus I needed a thicker string to bring it to a tension that was playable and close to the gut or steel strings I was comparing it against. Regardless of the string's thickness, or whatever tension was used, I found any of the other playing issues I was faced with still existed. The string thicknesses and weights I ended up using were: 1st string Silk A - 2.65 mm diameter (tuned to solo A as Bottesini), 7 grams, and Gut E - 2.83 mm (tuned to E solo), 14 grams. Although the strings are very similar in density, it seemed that due to the large difference in the weight between the two strings that I tried, perhaps silk is very slightly less dense and would require being marginally thicker (or loaded/coated/wrapped with metal) to

match its gut counterpart at the same pitch/length, countering the many reports in newspapers that mention Bottesini having thinner strings (*9*) (*10*) (*11*).

Wolfing

An undesirable effect that seemed to keep presenting itself when bowing lower positions/notes was that the string felt like it was persistently wolfing. The string often felt like it wasn't speaking properly with the string trying to cancel its own vibration out like a wolf note. This didn't ever prove to be a problem with the gut or steel strings. It felt like it was caused by how the silk interacts with the hair of the bow.

String surface

Written in Bottesini's Method, Bottesini specified he played on uncovered strings. He wrote, *"By using three plain strings we avoid the great inconvenience of two wire covered strings which by the very nature of their heterogeneous envelope allow of less pressure, and present more difficulties to the attack of the bow"*. (*2*) This means that we eradicate the possible variable of different types of metal windings that could have been put on top of a silk core.

To me the surface of the string is probably the most important and biggest factor that dictates the reality of these strings being used by Bottesini. In my experience of playing pure silk strings I have found that they have a favourable sound when plucked but simply do not work well under the bow. Regardless of whether the string was made from twisted or untwisted silk, I found two main issues that stopped me being able to produce a reliable sound. Both of these relate to how the hair of the bow interacts with silk as a material.

Gut has the ability to be polished into a consistently smooth outer surface (almost akin to plastic) and this is one of the many properties that have made it such a favourable material for strings for centuries. Although we know the 'Acribelle' strings made for the violin were polished to imitate gut (*12*), even for string lengths as short as the violin, the 3rd and 4th string would be wrapped in metal to avoid the difficulties mentioned above and to make the string play better.

This issue is only exacerbated as the string increases in size, requiring more and more twists of silk to

Figure 1

Plain silk string showing fibres separating from the string.

make the string longer and sticker. Pure silk on a string the size of a double bass will simply never be as smooth and polished as that of gut.

Even if the outer surface was polished, it would only be a matter of time before you would start to wear the fibres down, exposing unpolished fibres below and making difficulties with contact or grip, as explained by Heron-Allen in his Violin Making book (*12*). One of the biggest problems I have found in trying silk is that over time the outer layer disintegrates and mixes in between the hairs of the bow and the rosin. Micro fibres come off the string and protrude like the fine soft hairs on the back of the hand.

The photo above shows how different the two materials are and just how different the surfaces are, leading to difficulties with the interaction of the bow hair. It seems that covering them would be the only sensible option to make this a viable string.

Figure 2

Picture showing the string disintegrating and microfiber dust being left on the fingerboard.

How harmonics respond

One of my preconceived ideas was that silk strings would provide better, freer flowing and ringing harmonics than gut. With harmonics being such an integral identifying feature of Bottesini's compositions, it occurred to me that silk *must* perform better, helping Bottesini to extend the range of the double bass through their use. This meant his strings must have been capable of producing the sounds he wrote in his compositions. My experience of harmonics on plain silk is that it is far, far more difficult to produce harmonics that are less than a quarter of the string's length compared to gut. Simply put, the string fails to speak without considerable effort and preparation. Compared with gut it is far harder to make the 7^{th}, octave, and 9^{th} (intervals of the open string) harmonics speak, let alone any false harmonics. Harmonics require perfect hand positions before they will begin to speak; however, it is still incredibly difficult to make the smaller nodes of the string speak even with preparation. All of these elements would have meant that phrases would need to be played much more slowly to allow for these challenges, and some wouldn't be possible at all. When trying these shorter nodes I found the string would often choose to speak in a longer node, squeak, or not sound.

A summary of my experience

In all, the string was not what I was expecting. As noted above my ambitions were that the string would perform at a step up from gut, making all the things that Bottesini did more tangible. I, however, found the opposite. I was very surprised to find this and I certainly did not expect it to perform worse than gut; at minimum I thought it would perform on par. Tuning of the string was as unstable as gut too, something that I thought would have also been improved with silk.

In light of my findings, I wanted to try and find any instance in history that has mentioned silk strings for the double bass. I wanted to try and find reason for the statement, and to try and find any information that might provide answers on the reality of using silk as a string. Although my personal experience with plain silk as a string for the double bass did not work, I embarked on more in depth research to see if I could find any other experiences on using silk as a string or to see if I could find any information about the strings of the double bass in general.

Further Research: Evidence from other sources

Despite my experience not providing the results I expected, I have tried my hardest to try and prove the statement correct. I have tried to understand what brought the comment about and I have searched extensively for anything related to it that might have given me some answers, but alas it has been in vain. I have searched the national archives and newspapers of Italy, France, Germany, the UK, and America and have found no interview or review that specifies the material of Bottesini's strings. The closest I have found was a French newspaper report in 1856 some years before Bottesini's Method specifying that Bottesini's strings were unwrapped (*13*). Alongside this, all the information I could find in relation to the use of silk strings in research journals and articles had one common trait: there was no evidence of it being used on the double bass. Unfortunately the more I looked the more it seemed to reinforce the results of my own experiment.

Finding any mention of historical type or use of double bass strings are scarce; however I managed to read many articles that helped build a rounded picture of the use of strings being used in Bottesini's period and a little bit before. In an attempt to try and make finding information easier, I have compiled a catalogue of quotes of relevant information that I hope can be used to build your own opinion.

In my searches I couldn't find one example of plain unwrapped silk ever being used on a double bass and for that matter on the majority of any bowed instruments. The exceptions I found were the higher strings from an Acribelle string set for the violin and instruments from China, however in the west the Acribelle strings never found favour or became commonplace, with gut being perpetually favoured.

Instruments that use silk

From my research I found that the majority of uses for silk strings were on plucked instruments and not bowed instruments, reinforcing my own findings on silk's pizzicato sound, and undesirable nature when bowed. Any silk instruments that were bowed certainly didn't have the string length or string thickness of a double bass, removing many issues caused by the physics of the larger string. The most common use of silk strings in the western world I have found to be on lutes **(*14*) (*15*) (*16*) (*17*) (*18*)** and guitars **(*19*) (*18*) (*20*) (*21*) (*22*)** and after this the harp **(*23*) (*24*) (*25*) (*26*)**. In Persia, the Middle East, and China again, the majority of the instruments using silk strings were plucked.

The more I searched the more it seemed that others had drawn the same conclusions that I had come to with my experiment, and with each new piece of information my conclusions were drawing more and more towards the unlikelihood of the string being used for the double bass.

Two quotes in particular from my research stand out, summarising my experience.
One quote from Heron-Allen's book on 'Violin Making' was very useful:

"*All violin players are familiar with the now-common acribelle, or silk, strings, which are composed of an infinity of filaments of silk so twisted together and polished as to exceed in uniformity and transparency the finest gut strings. For players troubled with perspiring hands, and for hot or damp climates, they are, without doubt, invaluable, for they are but little affected by damp, and they make up in convenience in these respects what they certainly lack in tone. They are apt also to fray and get ragged, and though it has been recommended when this is the case to draw the string quickly through the flame of a spirit lamp, to remove the frayed fibres, an acribelle string once gone wrong, is ghastly with a ghastliness more easily imagined than described. The same remark applies to the twisted or plaited strings, sometimes known as Chinese water-cord. These are quite the best for players with hot hands, and are almost exclusively used by violinists in India and other hot countries, where the ordinary strings not only break very easily, but also are very difficult to keep. But, of course, their tone is inferior to gut."* (*12*)

The second was from Albert Cohen's research ' A Cache of 18th Century Strings'; his research summarised my findings entirely:

"*In it, Gossec writes of having sought the opinion of colleagues at the Conservatoire de Musique concerning the strings and of having strung a harp with them for a practical demonstration of their sound. All were convinced, he notes, that for plucked stringed*

instruments, the silk strings had as good a quality of sound as those of gut, while being more durable and better able to withstand higher tension. He adds, however, that the same did not hold true for bowed stringed instruments. Gossec argues that, because of their method of manufacture, silk strings conserve a grainy texture not characteristic of gut. This texture tends to separate the bow hairs when the strings are played upon, especially in sustained sounds, resulting in loss of resonance. Also, the texture makes the silk strings susceptible to being lacerated through friction created with the bow hairs." (*23*)

As we can see in these quotes, they describe the very same issues I described in my experiment with the fraying of the string and disintegration into the bow hair. This is perhaps less of a problem with powder rosin on a violin; however with bass rosin being so sticky it would certainly stick into the rosin and hairs more. The second point to note is how "ghastly" they think the sound is when the string isn't speaking properly. The string squeaking or whistling was a consistent problem I found on plain silk. (*23*) (*26*)

The only instances in which I found a plain silk string being bowed in the west were on instruments with generally smaller string lengths like those of the violin or viol. I could not find any account of an instrument with a string length the same or close to the double bass being bowed that used silk as a material; second to this, it was hard to find any string that covered bass frequencies that wasn't wrapped in metal. It seemed to be the only reliable way to get the string thick and at the correct tension to play.

Winding and longer string lengths

A consistent find throughout any article I read was that silk was always covered with metal as the need for the string got longer and thicker. This seemed apparent on every instrument that mentioned using silk, right from the shortest string length of the violin (*17*) (*20*) (*22*) (*27*) (*28*) (*29*) to the longest length I could find, the harp (*24*) (*25*) (*26*). To make silk work well as a bass frequency string it needed to be covered to give it extra weight and thickness to produce the frequencies needed. The longest strings I could find that were of silk manufacture were made by Baud (*23*) for the harp. One theory is that perhaps Bottesini tried a silk harp string to see how it works; however, according to Cohen's findings on silk harp strings, by the time the string length had reached that of the double bass, the strings would have been covered in metal, going against Bottesini's preference in his Method and disproving this idea for me.

Items specific to double bass strings

The focus of this research was to find out more information about the possibility of Bottesini using silk as a material for his strings on his bass; however along the way I have tried to find information that relates to double bass strings of Bottesini's period. Within the many research journal articles I read, mention of double bass strings or even bass viol strings are far and few between compared with that of the higher pitched instruments. However, when mentioned they seem to point always to gut in some form, whether plain or wrapped in metal. Paul Brun's book on the history of the double bass is a phenomenal resource for the instrument and he suggests, as I do, that Bottesini's strings would have been gut. One of the quotes mentioned in his book was: "*This was actually the case, as the Italian and the English then used un-wound sheep's gut for all three of their strings, which they tuned in fourths, A d g."* (*30*)

It seems that gut on the double bass was still in use until the 1950s, and perhaps even the 60s, before steel or metal strings started to become the norm. In an attempt to be a resource

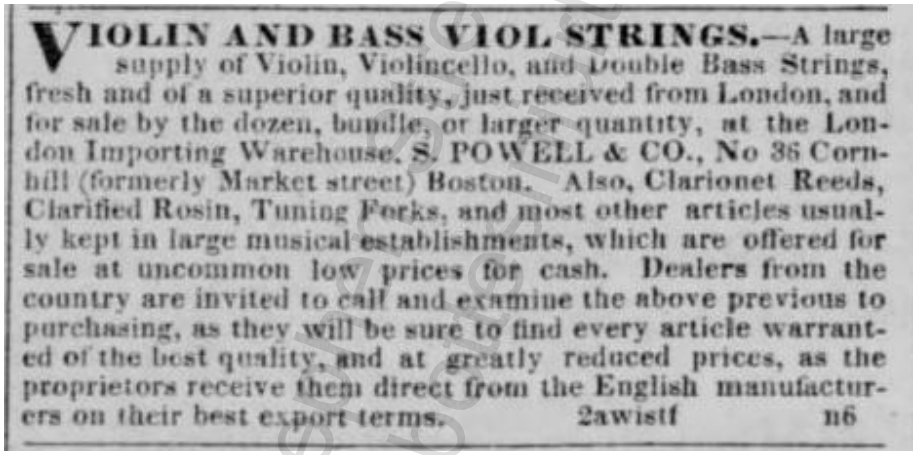
for bass players I have combined quotes or facts I have found relating to double bass/violone strings specifically into a catalogue at the end of this document for easy reference. These quotes had quite a large influence on my opinion.

Adverts for bass strings

Whilst searching newspaper and article journals, I looked for any adverts that mention or specify double bass strings for sale. For the most the material of the string is not mentioned, but I assume this is because they were made out of the most common material of the time - gut. Whenever an advert is found in the paper for Acribelle strings (or any other silk string), the advert will clearly specify the difference, as it was more unusual to find silk rather than gut. The other point to consider was that gut was often graded in quality, silk strings professed to be of the highest grade every time.

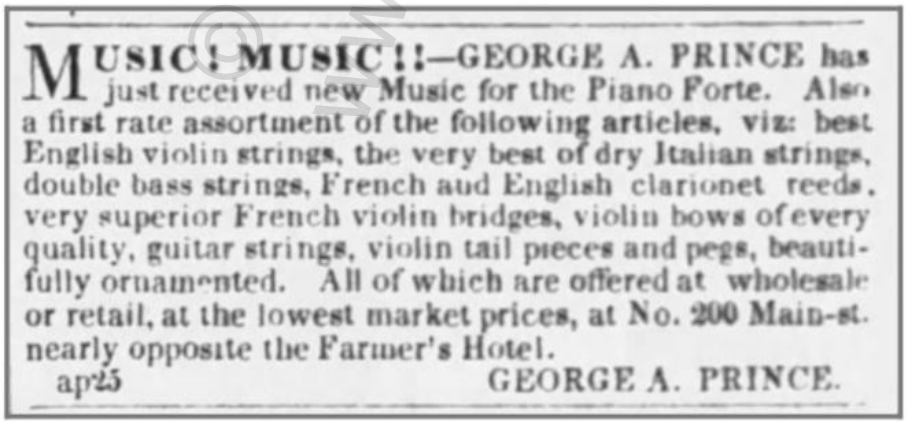
ROMAN VIOLIN STRINGS.—Just received, two hundred bundles, from Italy direct. Also, violoncello, guitar, harp, and double bass strings. W. H. PALING. 83, Wynyard-square, Sydney.

Figure 3 A String Advert from the Sydney Morning Herald (Sydney, New South Wales, Australia) (*86*)



VIOLIN AND BASS VIOL STRINGS.—A large supply of Violin, Violincello, and Double Bass Strings, fresh and of a superior quality, just received from London, and for sale by the dozen, bundle, or larger quantity, at the London Importing Warehouse, S. POWELL & CO., No 36 Cornhill (formerly Market street) Boston. Also, Clarionet Reeds, Clarified Rosin, Tuning Forks, and most other articles usually kept in large musical establishments, which are offered for sale at uncommon low prices for cash. Dealers from the country are invited to call and examine the above previous to purchasing, as they will be sure to find every article warranted of the best quality, and at greatly reduced prices, as the proprietors receive them direct from the English manufacturers on their best export terms. 2awistf n6

Figure 4 An Advert from the Boston Post Selling Strings (*87*)



MUSIC! MUSIC!!—GEORGE A. PRINCE has just received new Music for the Piano Forte. Also a first rate assortment of the following articles, viz: best English violin strings, the very best of dry Italian strings, double bass strings, French and English clarionet reeds, very superior French violin bridges, violin bows of every quality, guitar strings, violin tail pieces and pegs, beautifully ornamented. All of which are offered at wholesale or retail, at the lowest market prices, at No. 200 Main-st. nearly opposite the Farmer's Hotel.
ap25 GEORGE A. PRINCE.

Figure 5 An Advert from the Buffalo Courier listing double bass strings (*88*)

FRESH IMPORTATIONS OF MUSICAL Instruments.—G. W. BRAINARD & CO., No. 117, Fourth street, have just received, per Nacmo, direct from European manufacturers, their spring importations of Musical merchandise, such as

Violins, various numbers and styles, from 50 cents to sixty dollars;
Guitars, with and without patent heads, from very low up;
Guitar Cases, of wood and paste-board;
Violin do do do do;
Violin Bows, all prices, from 25 cts to $6 each;
Screws, Tail-pieces, Finger boards, and Bridges, for Violin, Violoncello, and double-bass;
Tuning Hammers, Tuning Forks, and Pitch pipes;
Patent heads for Guitars, various prices;
Guitar Pins and Screws;
Rosin, (in boxes,) superior French, German, and American;
Flutes; American and Imported, (variety,) from 40 cents to $50;
Violin Strings, all prices, from 50 cents per bundle to $4 Italian, French, German, Venitian, &c;
Guitar Strings made expressly for the Guitar, of superior strength and texture;
Violoncello Strings, assorted;
Contra Bass Strings, prime;
Harp Strings, English and French, superior;
Together with the largest variety of Sheet Music—of our own and Eastern print—to be found in the West.

All of which we offer to the trade, country dealers, schools, teachers, &c., on as favorable terms as can be obtained East or West. With a variety of Piano Fortes from the most celebrated and best known makers in this country. G W BRAINARD & CO.,
Sole agents for J. Chickering's Piano Fortes,
No. 117 Fourth st., Mozart Buildings
je28

Figure 6 Advert listing 'prime' double bass strings, suggesting gut as it was common to grade gut string's quality (*90*)

500 Bundles Violin and Double Bass Strings of the best quality. Also, superior Gudor Slugs at
dec 17 65 State street.

Figure 7 Advert from the Hartford Courant 1854 selling double bass strings (*89*)

Evidence from Photos

We are very lucky that Bottesini was photographed with his bass many times. This has proved to be a very valuable source for myself and other researchers. Not many people of that period had the opportunity to have their photo taken and it is testament to how important Bottesini was at that time.

Looking at his photos in detail, I have noticed some very useful details that help with determining what strings he used. Gut by its nature has some stiffness as a material, almost like a flexible plastic cord. It has the ability to retain its shape against gravity where silk will simply fall. This is shown in the next picture (also take note of the difference in colour).

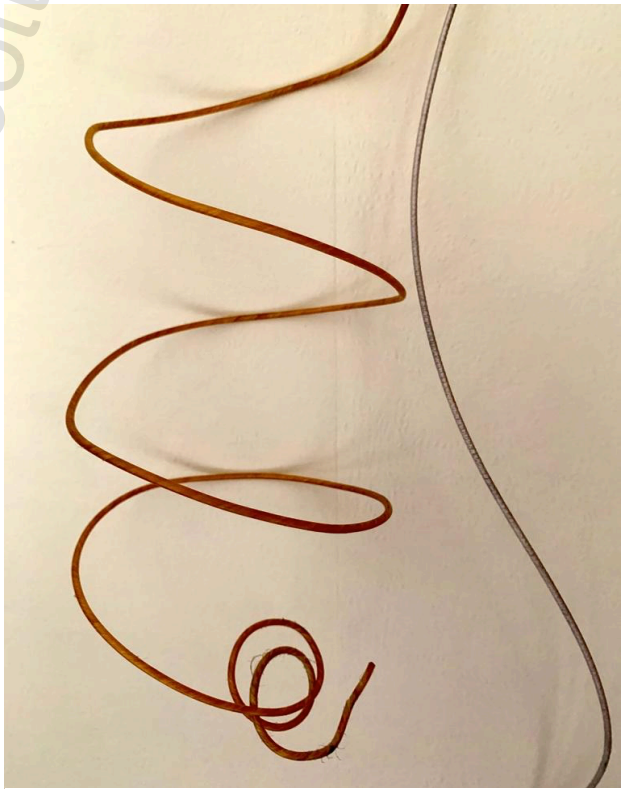


Figure 8 A comparison of Gut (left) Silk (right)

As seen in the photo above, gut has its own strength to be able to hold its shape and hold itself up against gravity. In nearly every photo of Bottesini, his scroll has thick coarse brown-looking strings projecting out of the peg box as shown in the next photos:

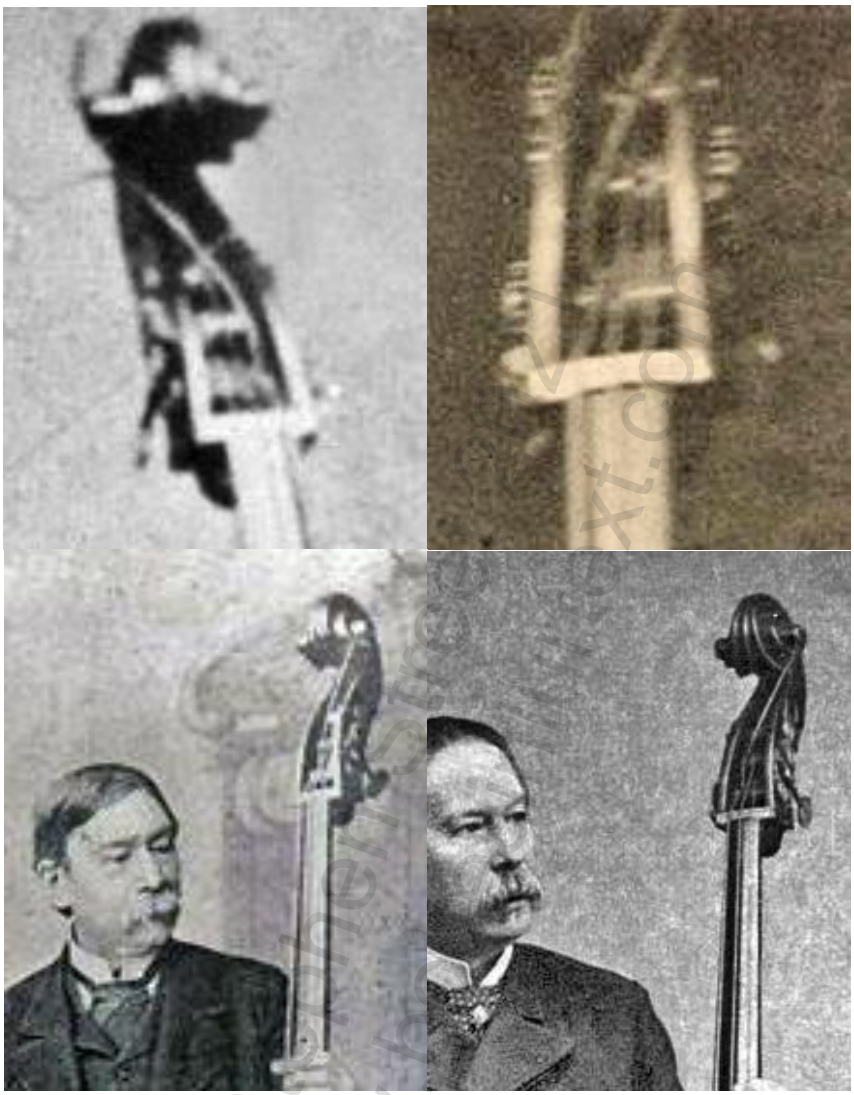


Figure 9 Showing Bottesini's peg box with gut strings protruding

Frankly, as shown in figure 9, silk doesn't have the core strength to hold itself out of a peg box as shown in these photos of Bottesini. My experience from trying plain uncovered silk is that although it can hold itself out some way out of the peg box, it cannot hold itself vertically up like those displayed in the images above. A silk string would require more core strength, like a gut string, to be able to do this, either being covered in a significant coating from a material or being wound with metal. Plain silk by itself did not have this.

A feature of silk strings is that they are usually bright white unless they have been dyed another colour. Sometimes on eastern instruments or other instruments such as the harp, the strings were dyed different colours to make it easier to understand which string you were playing; however in photos of Bottesini, the strings look like they would be various shades of brown and not the strong striking bright white of silk, and they are certainly not colour-coded for that matter! The photos of the strings on Bottesini's bass look coarse and thick, just as you would expect a gut string to look like.

A further point to make is that the string's material matches each other from string to string. There doesn't seem to be any mixing of material or a change in the type of string. It has been suggested that Bottesini used a 'cantino' string, discussed below.

The 'cantino' string

A prominent researcher on Bottesini is an Italian scholar named Luigi Inzaghi, writing two books on the maestro (one currently unpublished) and providing a wealth of previously unseen information and gems of Bottesini research.

Within his first book written on Bottesini, there is a small section talking about the 'cantino' string of Bottesini:
"..oltre ad accordare lo strumento per quinte, monta un canti no di seta invece dei soliti imperfetti di budello o di cor da: i suoni gli risultano così più nitidi e gli armonici di grande effetto virtuosistico." (*31*)

Translating as:
"he mounted a silk cantino instead of the usual imperfect ones made of gut or horn: the sounds were thus sharper and the harmonics of great virtuoso effect." (*31*)

The book suggests that Bottesini used a cantino string, thus meaning he only changed his highest string to silk and the others remained as gut. After discussing this section of the book with Professor Inzaghi, he informed me that this information was passed on to him by Rodney Slatford and was as a result of his findings. There is an inconsistency here with the information Rodney Slatford's presents in his editor's note (*1*) and what was passed on to Prof. Inzaghi. Rodney Slatford specifies silk strings as a plural rather than just one in his editor's note, yet in the information given to prof Inzaghi it was specified that it was just the highest string.

If Bottesini had changed just one string, photos would show a difference in colour between the highest strings and the other strings of the bass. This would have been particularly noticeable on the areas of the string that wouldn't have been susceptible to the wear or discolouration of rosin and hand grease.

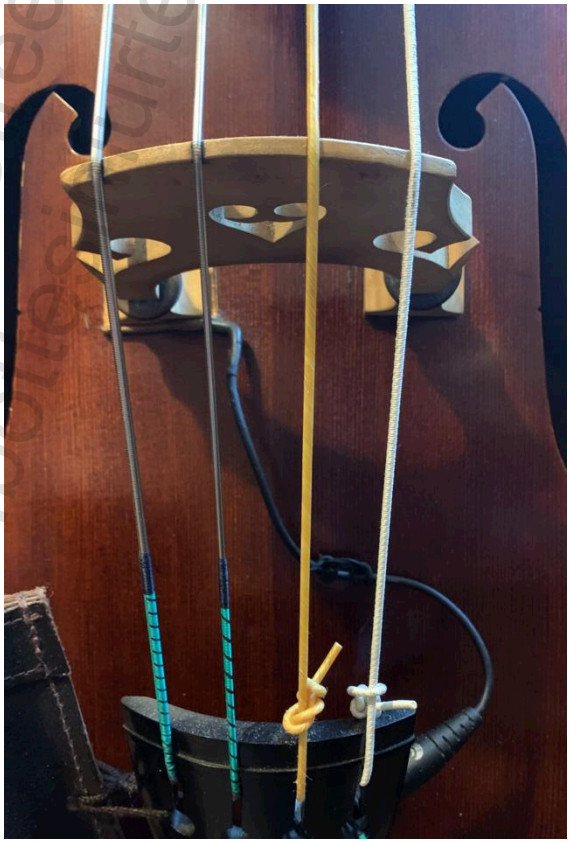


Figure 10 Showing the contrast in colours between strings

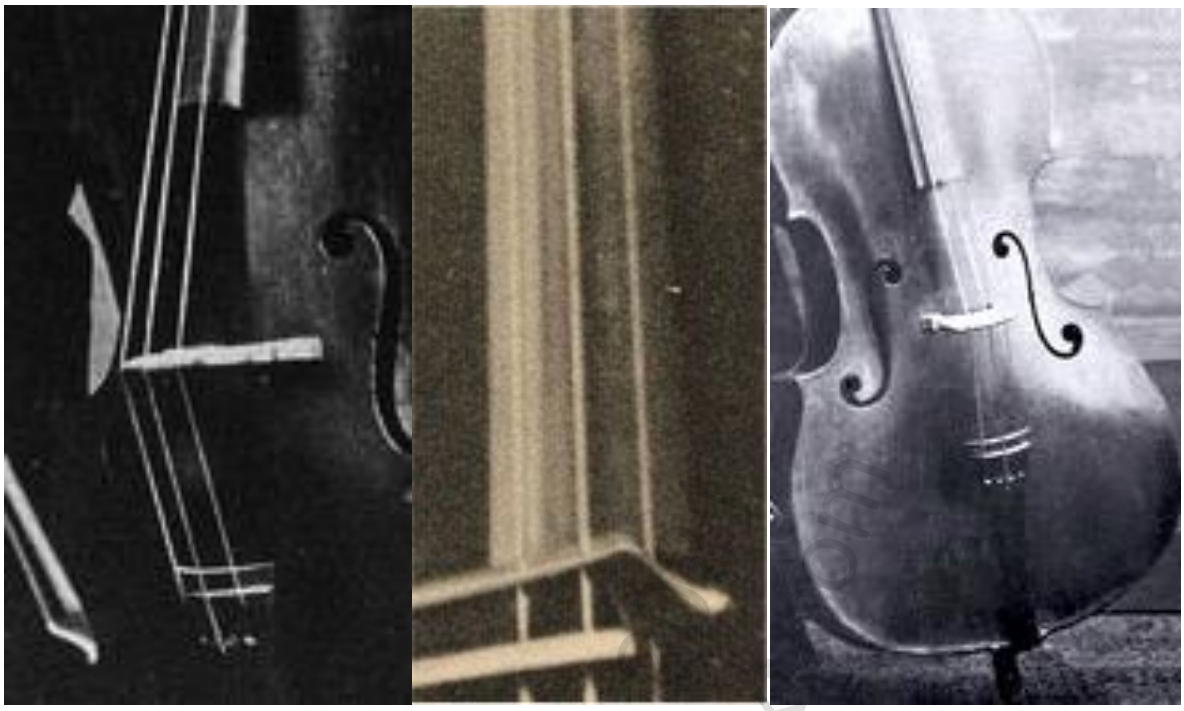


Figure 11 Showing a consistent colour and material across strings in photos of Bottesini's bass.

The photos above show no difference between each of the strings, all having the same matching texture of colour, suggesting they are all made of gut and unwound.

Further to this, my results found that blending the two strings was near impossible due to the different response of each string and the tonal quality of each string. When playing passages across the gut and silk strings, it was impossible to constantly match the bow speed of the two strings due to silk's speaking so much more slowly. Slurring phrases across the strings usually meant a squeal would emit from the silk string when string crossing.

Second to this is the vast difference in timbral colour between the strings. There was a marked difference between each string, making it very easy to tell which string you were playing on. It is very difficult to blend the silk to the other strings and only would have stood out if Bottesini was playing with this set up. Again I couldn't understand the logic of having two very different sounding strings, as it would only detract from the performance.

Bottesini's thin strings

Over the last few years of researching, I have found quite a few papers reporting on Bottesini using 'thin strings'. I previously thought this was due to the fact he was using silk, but after my results of my experiment and thanks to delving deeper into this project I have perhaps found the answer behind this. Newspapers I have found in the UK and America describe Bottesini using strings that were 'thinner than usual' (*32*) (*33*) (*34*) (*35*) (*11*) (*36*) and I wondered what might be causing this. It wasn't until I read Patrizio Barbieri's research entitled *Roman and Neapolitan Gut Strings* (*4*) that I found out some potential reasons why. The highest quality gut strings were manufactured in Italy and were labelled "Roman strings", and it was due to the unique combination of climate, the type of sheep, their diet and the Italian manufacturing process that they were able to manufacture strings of higher quality than their French or English counterparts. Alongside this the Roman strings were often slightly thinner than strings made in other countries as a result of the reasons listed above. It would make sense for an English newspaper to notice this

anomaly when an Italian virtuoso, bringing "Roman strings"' with him, compares these with the thicker gut strings produced in England.

Also in this article is a hypothesis suggested by Mimmo Peruffo that "by soaking the gut with finely powdered heavy metals (e.g. copper) in order to increase its density and thus make possible the use of smaller diameters". (*4*) However the article claims there is no evidence to support this yet.

One consideration is that his thinner strings were due to his tuning. Taking a conventional string (normally used orchestral pitch) and tuning it a tone or a minor third higher is going to put more stress on the string thus pulling it tighter and thinner. Perhaps Bottesini's aims were to both improve tension for projection and to make the strings thinner, allowing harmonics to ring out better and also perhaps answering what Bottesini meant in his Method when he said, "*wire covered strings which by the very nature of their heterogeneous envelope allow of less pressure, and present more difficulties to the attack of the bow."* (*2*)

The final consideration I had on this matter was perhaps that musicians and the press were used to seeing a thicker string, due to the wrapping of metal on top of the string which was commonplace to make lower strings work better in this period and by strings made in England or France being made thicker as standard. A point to note however is how many missed opportunities journalists, critics and papers had to point out the material of his string despite noting a far much smaller detail, namely its diameter. I discuss this a little further on.

Silk products that were available at the time of Bottesini

Throughout my research I have found evidence of silk products being used on instruments for centuries (*37*) (*38*) (*23*) (*39*) (*40*). I have however tried to focus on what silk products may have been available when Bottesini was alive, 1821 - 1889. I have found silk strings in different forms manufactured in Bottesini's lifetime, with newspapers providing evidence of products being made for instruments, but as for bowed instruments I could only find one product being made for the violin. The silk strings I found manufactured in Bottesini's time were metal wound silk core strings for the guitar, Bauds silk strings for the harp (both plain silk on shorter lengths and metal wound silk in the bass strings), and finally a slightly unusual instrument: the 'clavi-harp'. This instrument had wire core strings which were wrapped in silk and then wrapped in metal again, with the silk used to try and soften the attack of the string and have an attack of sound similar to harp. This method was also tried by Bille at least 20 years after Bottesini's death to try and make a more successful string and in his book he writes:

"*Per quanto il nostro Metodo sia stato pubblicato nel 1922, noi fin dal 1910 facemmo delle esperienze per aver le corde gravi del contrabasso più sonore e più sottili, rivestendo degli adeguati fili d'ac- ciaio prima con seta poscia con rame, cosa oggi già perfezionata e messa in pratica (abbiamo veduto un cantino sottilissimo) mediante la sostituzione del rame con l'alluminio, ciò che ha tolto al suono ogni asprezza metallica".* (*41*)

Translating as:

"*Although our Method was published in 1922, since 1910 we have been experimenting with making the bass strings of the bass drum more sonorous and thinner, covering the*

appropriate strings first with silk and then with copper, something that has now been perfected and put into practice (we have seen a very thin cantino) by replacing copper with aluminium, which has removed all metallic harshness from the sound". (*41*)

Again, however, this doesn't fit with Bottesini's preferences of a plain string unwrapped without metal, nor does it occur in his timeline.

The only readily made silk strings for bowed instruments that could be purchased in a shop were the Acribelle strings for the violin, and from what I can deduce they consisted of two plain silk strings that were soaked and polished (like that of fishing twine) and two lower strings that consisted of a silk core wound with metal.

I have searched relentlessly for any plain silk products that were used on bowed instruments of longer string lengths and have come across nothing. It also seems that Acribelle strings (or Baud's harp strings for that matter) never seemed to gain popularity, mainly due to the issues that Heron-Allen describes which were only compounded in my experiment with the longer string length of the double bass.

The earliest advert I managed to find to date for the Acribelle strings was in the French newspaper *Le Constitutionnel,* published on the 2nd of April 1855. (*42*)


CHANTERELLES DE VIOLON perfectionnées dites ACRIBELLES, invention brevetée s. g. d. g. Fabrique, rue Sainte-Geneviève-de-Chaillot, 9, à Paris. Vente chez tous les bons luthiers de France. (1659)

Figure An Advert for Acribelle Strings in the Le Constitutionnel 1855
CITATION LeC55 \l 1033 (*42*)

The readily availability of spares

Another facet I considered whilst conducting this research was the readily availability of spare silk strings for Bottesini's bass. If Bottesini used such unique, hard to find strings, what would he do when he was constantly touring or spending many months away from the supplier of these strings? Bottesini was exceptional in the amount of touring and travelling he did in his time, travelling from place to place his entire life. He would have spent months if not years away from Italy and thus would need replacement strings when they had worn out or spares if one were to snap. With no record of anyone manufacturing silk strings for the double bass in the countries he travelled, from where would he obtain them, and how many would he have carry with him in case they were to break? Why would Bottesini make things intentionally harder for himself trying to source, or having silk strings sent to him, when the finest 'Roman' Italian strings worked perfectly well and were readily available in nearly all the places where he travelled? He would have had to have kept a couple of complete sets with him at all times and if they were so unique and valuable, people on his tours would have taken interest in either purchasing their own or one of Bottesini's strings. There would have been countless opportunities for the press, music critics, and other players to meet Bottesini and yet all of them seem to have missed the fact that he was using a different string from others.

Bottesini in the papers/Interviews with Bottesini

Throughout his life, Bottesini's was extensively interviewed and documented in papers and books, often giving a personal account of life in the arts of the period. Something that always comes across in articles is how approachable and kind-hearted a man he seemed to be, who was very welcoming and willing to answer questions for anyone taking interest. It is from this we can find out many interesting facts and opinions about his playing, as he was so forthcoming with his thoughts. In this case, why in all the many interviews he gave in his life, did he not detail anything about his strings as he did other parts of his equipment?

Bottesini was well known for his opinions on his choice of bow; this was made very clear in many interviews (*43*), so why did he not have more of an opinion on his strings? He does clearly specify unwrapped/uncovered strings in his Method; however it strikes me as a little unusual (knowing how precise Bottesini was) that he wouldn't clarify this further and mention what the string was made of, if it were different from the norm of the time. Why did Bottesini fail to mention it in any interview, or why are there no accounts by journalists talking about silk strings specifically? I find this bizarre.

If Bottesini made a point of using different strings from others, it would be one of the integral features of his sound and would be one of the many features that would be mentioned about the spectacle that was Giovanni Bottesini. Bottesini is very frank about his opinion about German bow players "with the bow impeding the vibrations of the string", and so if silk was a far better material for him to use, why would he not be just as frank about this as he was his bow, listing its advantageous properties and popularising its use alongside the use of the French (overhand) bow?

A quote from the *Revue ET Gazette Musicale de Paris*, 2nd March 1856, ratifies Bottesini's comment made in his Method (published many years later in 1869 in France) stating:

"*M. Bottesini se sert tout simplement de la contre-basse classique à trois cordes, la troisième qui n'est pas filée, comme on dit en terme delutherie…"* (*13*)

Translating as:

"*M. Bottesini simply uses the classical three-string double bass, the third string not being spun, as they say in the term 'delutherie'…"* (*13*)

Here the journalist has taken their time to specifically talk about Bottesini's strings. How many he has, the fact that the string is unwrapped/uncovered and that the string is plain. Why hasn't the journalist pointed out that any or at least one is made of silk? The only thing that must make his strings different from what was common at the time (gut) is the fact that it is unwrapped, not the fact it is made from a different material such as silk. It would have been significantly noticeable if a string were made out of silk compared to gut if the journalist were looking in such detail.

Research by others

Over the course of the last couple of years of research, I have come across two other prominent researchers that have also looked into this subject, and I thought this would be a

fantastic time to highlight their hard work. I have tried to work independently of their findings on purpose to see if our experiments produced different results.

Korneel LeCompte

Maestro LeCompte is an authority on period performance and his dedication to this is inspirational. Materials that he has published online show many years of conscientious hard work and experience, providing many eye-opening ways on how to interpret pieces and how performers can approach these on period instruments.

One area he also studied was that of the claim of 'Bottesini's silk strings'. I purposefully did not read his findings until I had completed my experiment independently so that I could compare what I found with his experience. His findings are published on his website under the web page entitled *The Silk Road* (*44*).

Early on in his findings Maestro LeCompte suggests, perhaps due to the fact that Bottesini doesn't mention silk strings in his Method, that perhaps he tried them after the method was published around 1869. (*45*) It might be worth considering photographic technology was not so readily available in Bottesini's early career with the first photographs being taken in 1826 (*46*), five years after Bottesini's birth. This meant that photographic equipment wouldn't have been readily available until a few years after that and the photos showing what appear to be gut strings would have been taken in his mid- to later career, and the clearest photos likely after 1869 as photographic technology continued to develop.

An interesting comment in his findings was made by Gerold Genssler, claiming:

"*zu seide: ich weiss, dass bottesini eine zeit lang seide gespielt hat. allerdings hielten die saiten nur ein konzert lan."*

Translating as:

"*About silk: I know that Bottesini played silk for a while, but the strings only lasted for one concert*."

Unfortunately, like the original Rodney Slatford quote, it is unreferenced and provides no source of the information. It seems to me very impractical to change your string every concert, especially at the frequency Bottesini was playing - it strikes me as a big financial and physical hindrance, and poses the question, why would you want to perform on a string that was so unreliable?

Another discovery in this article was Robert Nairn's experiment with silk strings, who surprisingly claimed to have had positive results, but who does go on to report tension issues, difficulties working with the string surface, and issues with the string holding its tuning, all things I would consider paramount to the success of a string and similar to what I found. Robert Nairn then continues to quote Rodney Slatford's quote in the *Complete Bottesini* (*1*) as the inspiration for his experiment.

One of the most important parts of Maestro Korneel LeCompte's research was the communication with Rodney Slatford himself asking for more information. Rodney replied:

"*My Bottesini research is all packaged up and temporarily in store, following a major office relocation, so I can't say where I found the quote about Bottesini's strings".*

Therefore Rodney Slatford unfortunately failed to provide a source for the information. I know, since Maestro LeCompte's contact, that others, including one of Korneel's students Pasquale Massaro, have tried to contact him since and have been given the same response, even if it were years after. Pasquale commented to me on social media:

"*We asked Rodney Slatford about his sources on Bottesini's silk strings, but he never answered sufficiently 'Yes silk bass strings exist in some form in history, but of course the strings are wound and lower for orchestral practice.'"*

Unfortunately Mr Slatford has never provided a source to date.

An interesting aspect of Maestro LeCompte's research is that he has strings made with a significantly harder outer coating on, which were very different from mine, and appear different from baud's harp silk strings made in Bottesini's time. Maestro LeCompte was presented with some difficulties when the outer layer of his strings cracked and made them overly stiff to use.

"*I noticed the strings are very stiff. They resist being uncoiled and they want to go back to their "coil spring" position (see photo). Making the knot is hard, but I "crack" the string's end so as to make it a little more supple."*(*44*).

This tough outer layer seems to make the string behave closer to metal in the sense that it was quick to tune and take tension, unlike my plain silk strings that were as unstable as Gut. Maestro LeCompte did find some similarities in his research, but also, however, some complete opposites.

"*The sound in pizz, as I tune up, is very clear and trebly, which makes me think this would be a fantastic jazz string. The feeling to the fingers is different from smooth gut. It's a little rougher but in a pleasant way. The sound under the bow is very silvery. It seems to contain a lot of high harmonics; it's brilliant without becoming harsh. It also contains enough bottom end, so that it really feels like a bass string. It behaves very well when bowed: the bow has a good grip on the string, even though it's just been re-haired and there's no rosin residue on the string yet."* (*44*).

I feel this outer layer accounts for many of the problems I came across with a plain uncovered silk string, functioning almost like a metal winding that was used on strings to make them perform better. I admit the outer coating does provide a colour matching solution to gut, with the colour becoming much the same, however looking at the more detailed photos we have of Bottesini's bass, it is possible to see there is no 'rope' style construction on his strings (central photo figure 11) as there is in the thicker strings that Maestro LeCompte tried, and that Bottesini's strings are uniformly matched. The question I pose with this thicker outer layer is, would it class as a plain string if the coating were acting like a winding? A point that the maker, Alexander Raykov makes is that you would need to *'"pre-crack" the string by fixing one end at the string holder, holding the other end, turning string once around a pencil and rolling it all along the string,'* or play the string until *'The string acquires uniform flexibility without cracking in 8-10 months, a seasoning of sorts.'* I ask would Bottesini have gone through all of this when you can put a

gut string on and have it play straight away? Again, it leads me to wonder what he would have done when touring with spares - a few bad concerts until the string had uniform flexibility? Would a musician of his standing have time for a string to bed in like this without receiving negative reviews in the press? Would Bottesini have put up with "*the bumps that are very noticeable in the left hand",* and wouldn't we have noticed these blemishes in the photos of Bottesini?

Maestro LeCompte, in his blog, takes his research a couple of steps further than mine by travelling to Japan to try strings that were originally made for traditional Japanese instruments. In a couple of personal exchange emails a few years after his blog post in 2020, Maestro LeCompte provided these insights:

"*In my own experience, after many experiments, I believe silk is OK for the upper strings only: A (1st string) and E (2nd string) in Solo Tuning. If you want to use a high C-string, silk works very well too.*

For the lower strings B and F#, I don't think silk works very well.

If Bottesini ever used silk strings (and that's a big IF, because we don't know for sure), I would suppose he used a gut string for the 3rd string, and silk only for the top two strings. This combination works very well!"

It seems even after many years of research, maestro LeCompte doesn't feel there is conclusive evidence to prove Rodney Slatford's statement true. Secondly, it seems that he has not found a way of making silk work uniformly across all strings as a complete set, and it seems if Bottesini were to use this material that he would have to mix string type, something that he didn't seem keen on even between plain gut and gut wound strings. The historical bass world today is still using, and very focused, on gut and all its permutations, and silk hasn't yet been widely taken up around different research hubs. The end of the article suggests that the study is diversifying into the string's historical context before Bottesini's time: in period performances with different tunings such as Viennese tuning, and for use in performing pieces from earlier periods, due to the fact that silk has been used as a material for strings for centuries. To me it also suggests a 'string of the future' by trying to make it work as a new string rather than purely relating to Bottesini. An endeavour to find a new string that has sustainable properties is something I wholeheartedly support.

Although I have played devil's advocate in analysing Maestro LeCompte's research, it is aimed in a compassionate way, searching for answers to this question, and something I hope will spur further ignition to this topic. I am incredibly grateful for all of his research and information. His experiment into silk strings was a main impetus for me to conduct my own research, so I thank him for his inspiration and all the contributions he has made to the bass community in so many areas.

Rafael Vélez

Whilst in the process of conducting my research I was contacted by another fantastic bass player from America who was also looking into the different material properties of strings and how the advantages of different types of string could help turn the bass into a transposing instrument, through re-tuning for different instances. His principle was similar

to that of wind instruments in Bb or Eb: that the double bass could become a transposing instrument to fit into the instruments around it by tuning to their keys, thus taking away the need to transpose music and awkward keys for the double bass. To facilitate this, he tried modern metal strings, gut, and finally silk. He chose the latter two due to their nature of lower tension, allowing for a greater range in tuning without putting unnecessary stress on the bass. He has recorded videos comparing the properties of each of the strings and how they sound. These can be found on his YouTube channel, Rafael Vélez. They are a very useful resource for comparison in the sound of the strings.

The final straws that broke the camel's back

Sometimes in life, what you are looking for can be found right under your nose. It wasn't until I completely translated one of my republications, the book *In memoria di Giovanni Bottesini* by Antonio Carniti (*47*) that I found tucked away in this book a first hand account of an audience member describing what strings Bottesini used. The book contains a transcript from an article titled *Bottesini A Napoli*, which was published as part of a series of volumes entitled *Miscellanea di cose cremasche*. These volumes are located in Crema's Communal Library and this article can be found in volume one of six. I have since been in contact with the Comune di Crema and have confirmed the publication's existence.

A section from the article reads (in Italian then English):

L'arte contrabassistica del Bottesini era tale da interessare non solo i dotti, ma da sorprendere ogni genere di persone, rendendole spesso di buon umore. Prova ne sono le svariate caricature che del Bottesini furono stampate ed i numerosi scritti umoristici su di lui pubblicati. Nel Volume L 1/6 " *Miscellanea di cose cremasche*" che si trova nella Biblioteca Comunale di Crema, a pag. 220, è riportato un allegro e bonario popolare articolo, intitolato: BOTTESINI A NAPOLI che si riproduce, non tanto per il suo valore intrinseco, ma come una sincera impressione dell'effetto irresistibile che la sua arte contrabassistica esercitava sulla folla.

Foste mercoledì a Monteoliveto a sentire il contrabasso magico di Bottesini?

No.

E perchè non ci andaste?

Perchè tutti i biglietti erano esauriti.

Bella ragione!

Oh! se aveste veduto Bottesini a cavallo al suo contrabasso, stringerlo, percuoterlo, carezzarlo, pizzicarlo, baciarlo, come si farebbe di una cara .... cosa, avreste fatto il diavolo a quattro con le mani e con la gola, precisamente come fecero tutti i presenti, come hanno fatto i passati che lo hanno udito, e come faremo tutti futuri che avranno il piacere di sentirlo.

lo me ne uscii dall'accademia con una testa grossa quanto la botticina di Bottesini, alias il suo contrabasso.

Signor Bottesini carissimo, arcicarissimo, perdonatemi, io mi levo il cappello alla vostra abilità, e me lo levo a due mani, ma vi tengo pel primo professore....prestigiatore.

Negatelo e scusatevi, come volete, ma io vi dico e vi sostengo che il vostro contrabasso grosso grosso voi ci avete nascosto tanti diavoletti, e diavoloni, dei quali uno è il professore di clarinetto, un altro un suonatore di oboe e poi ci avete una ventina di violini, 5 viole, 2 violoncelli, un corno, un trombone, ed anche un pianoforte verticale, o con la coda, come vi piace. Non dite di no, perchè se tutta questa roba non ista nascosta

dentro il vostro contrabasso, dovrò dire che non è vero che voi avete suonato, oppure che non vi abbiamo udito, io e 800 o 900 persone.
Voi che domine fate con quella botte fra le gambe? Dall'ultimo degli strumenti, dal papà, dal nonno, dal bisavo del violino, della viola, del violoncello, e di tutta la famiglia delle budella di animale accordate e scordate sopra un cassettino o cassettone di legno, voi avete l'arte, la scienza, il talento e l'artifizio di stillare tanta dolcezza, tanto sentimento, tanta vita, anima, affetto ed efftetto da fare stordire mezzo mondo, perchè suppongo che l'altra metà la facessi restare stordita io con la lettura di questo che scrivo.
E tutto questo sopra tre budella di vacca strofinate da quattro crini della coda di un cavallo! Far cantare le budella e le code delle bestie è quanto si può dire di più incredibile e sorprendente!
Ma Bottesini veramente non è lui quando suona.
Potrebbe essere, per esempio un Giove Olimpico; l'aquila maetosa sarebbe rappresentata dal maestoso strumento che tiene fra i piedi, l'archetto nella destra è lo scettro, la sinistra è armata da fulmine.
Un fulmine! misericordia!

…..Continua

Quelle benedette tre budelle secche di Bottesini ci avevano legati su quelle sedie, stretti, pigiati, incomodi, sudando e spietati che non ce ne volevano far andare. Spietati pure fummo; gnorsì. Si ebbe il coraggio di chiedere al Paganini e al Thalberg del contrabasso il bis del Carnevale di Venezia! Ed egli lesto là con una faccia ferma, e artisticamente compiacente, tà, tà, tà - zì, zi, zì, - bu, bu, bu, -- nta, nta, ... (*47*)

This translates as:

Bottesini's contrabass art was such that it not only interested the learned, but also surprised all kinds of people, often putting them in a good mood. Proof of this is the various caricatures of Bottesini that were printed and the numerous humorous writings about him that were published. In the volume L 1/6 "Miscellanea di cose cremasche" which is in the Biblioteca Comunale di Crema, on page 220, there is a cheerful and good-natured popular article, entitled: BOTTESINI IN NAPLES which is reproduced, not so much for its intrinsic value, but as a sincere impression of the irresistible effect that his contrabass art exerted on the crowd.
Were you in Monteoliveto on Wednesday to hear Bottesini's magical double bass?
No.
And why didn't you go?
Because all the tickets were sold out.
Good reason!
Oh! If you had seen Bottesini riding his contrabass, squeezing it, poking it, caressing it, pinching it, kissing it, as one would do with a dear.... thing, you would have played the devil with your hands and with your throat, exactly as all those present did, as the past ones who heard it did, and as all future ones who will have the pleasure of hearing it will do.
I came out of the academy with a head as big as Bottesini's botticina, alias his double bass.
Signor Bottesini, dearest, most archaic, forgive me, I take off my hat to your ability, and I take it off with both hands, but I hold you for the first professor....prestigiatore.

Deny it and apologise, as you wish, but I tell you and I support you that your big big double bass has hidden many little devils, and big devils, of whom one is the professor of

clarinet, another an oboe player, and then you have about twenty violins, five violas, two cellos, a horn, a trombone, and also an upright piano, or with a tail, as you like. Don't say no, because if all this stuff isn't hidden inside your double bass, I'll have to say that it's not true that you played, or that we didn't hear you, me and 800 or 900 people.
What are you doing with that barrel between your legs? From the last of the instruments, from the father, from the grandfather, from the great-grandfather of the violin, of the viola, of the cello, and from the whole family of tuned and un-tuned animal guts on a wooden chest, you have the art, the science, the talent and the artifice of pouring out so much sweetness, so much sentiment, so much life, soul, affection and effect as to stun half the world, because I suppose that the other half would be stunned by my reading this that I write.
And all this over three cow's guts rubbed by four horse's tail hairs! To make the guts and tails of beasts sing is as incredible and surprising as can be said!
But Bottesini is not really himself when he plays.
He could be, for example, an Olympic Jupiter; the majestic instrument he holds between his feet would represent the majestic eagle, the bow in his right hand is the sceptre, the left hand is armed with lightning.
Lightning! Mercy!

This continues, and a little later is written, as quoted below:

Those blessed three dry guts of Bottesini's had tied us up on those chairs, cramped, pressed, uncomfortable, sweating and ruthless that they wouldn't let us go. We were ruthless too; gnorsì. We dared to ask Paganini and Thalberg for an encore of the Carnival of Venice! And he stood there with a firm, artistically compliant face, tà, tà, tà - zì, zi, zì, - bu, bu, bu, -- nta, nta, (*47*)

As is clearly depicted in this very colourful and complimentary article, the author takes time to share his first hand, in-person experience of seeing Bottesini perform. The author also takes the time to mention specifically (twice) Bottesini's use of gut strings on his double bass.

The final straw that broke the camel's back was found in a letter between Bottesini and his close companion, Cellist Paolo Rotundo, for whom which Bottesini is known to have written quartets, and performed alongside. A letter discovered by Enrica Donisi in her fantastic book *La Scuola violoncellistica di Gaetano Ciandelli* (*48*) compiles letters between Bottesini and Rotundo with one very useful letter in particular:

Parigi 16 maggio 1865 14 Boulevard des Martyrs

Carissimo Paolo

Ho ricevuto la cassa della biancheria e ti ringrazio della pena che ti sei dato per me. Spero di mandarti quanto prima il saldo del mio debito. Lo avrei già fatto se la casa non mi spogliasse troppo [...]. Ho perduto le parti del mio ultimo quartetto e non avendo più la partitura ti pregherei volermene inviare una copia. Ti sarebbe d'incomodo dire a Scielzo che mi ordini una dozzina di cantini, sei seconde e tre terze per il mio contrabbasso? La misura esiste presso il Signor Ruffini.

Ho veduto qualche volta Boubée, che credo sia andato a Londra. Prima che ritorni a Napoli spero rivederlo ed incaricarlo di tanti saluti per te. Noi stiamo bene e ti salutiamo.

Ricordami ai tuoi fratelli, a Federico, a Serafina. Salutami Napoli. Se vedi Troisi digli che non mi dimentichi.

La Regina di Spagna ha accettato la dedica della mia Marione Delorme [...]. Stai sano ed allegro e qualche volta ricordati del tuo aff.^{mo} *amico*

Gio. Bottesini.»

Translating as:

"Paris 16 May 1865 14 Boulevard des Martyrs

Dearest Paulo,

I have received the crate of linen and I thank you for the trouble you have taken for me. I hope to send you the balance of my debt as soon as possible. I would have already done so if the house did not strip me too much [...]. I have lost the parts of my last quartet and as I no longer have the score, I would ask you to send me a copy. Would it be inconvenient for you to tell Scielzo to order me a dozen cantini, six seconds and three thirds for my double bass? The measure exists at Signor Ruffini's.

I have seen Boubée a few times, but I think he has gone to London. Before he returns to Naples I hope to see him again and send him lots of greetings for you. We are well and we greet you.

Remember me to your brothers, to Federico, to Serafina. Give my regards to Naples. If you see Troisi tell him not to forget me.

The Queen of Spain has accepted the dedication of my Marione Delorme [...]. Stay healthy and cheerful and sometimes remember your dear friend

Gio. Bottesini."

Combined with the first hand account and this letter, we know not only that he played on gut strings but also that he specifically played on strings made by the renowned Italian gut string maker Ruffini. Ruffini strings was a world famous family-run gut string manufacturer, passing through at least three generations: Francesco Ruffini, Andrea Ruffini and Pietro Ruffini. Bottesini specifies twelve first strings, six second strings, and finally three third strings. Also revealed in this correspondence is that Ruffini strings must have been Bottesini's preferred supplier, having all his specifications to hand, and knowing from previous interactions that they were also not to be wrapped. We also learned that he kept many spares, and deducing from the numbers, replaced his upper strings more frequently. More information on Ruffini strings and Italian string manufacturers can be found in the following research articles: Patrizio Barbieri's *Roman and Neapolitan Gut Strings 1550-1950* (*4*) and Mimmo Peruffo's *Italian violin strings in the eighteenth and nineteenth centuries: typologies, manufacturing techniques and principles of stringing* (*16*)..

Since discovering this first hand account in my republication of *In Memoria di Giovanni Bottesini*, and Bottesini's letter to cellist Paolo Rotundo, I feel (at least for me) there is no

longer any reason for me to believe that he used silk strings. I do not dispute the possibility of one being manufactured or taken from another instrument and experimented with by many over history, but with regards to its being the main choice of string that Bottesini used, I don't think that it would have made it to performance. I feel there are too many hurdles to overcome with this string that would have posed too much of an inconvenience or hindrance to Bottesini's playing, especially as there is such a well-established readily available string that works.

Possible reasons for Rodney Slatford's comment

Over the process of this research I have thought long and hard about what the possible explanations are for this comment, its possible sources, and how to process it in the context of bass history.

One of the predominant thoughts behind the quote is that it was a 'copy of a copy', a repetition of a misunderstanding by a journalist that has potentially been repeated from a first account that wasn't wholly accurate, or like Chinese whispers, has changed the more times it has been passed on. We are well aware how there is artistic license in journalism both in history and amongst social media today so I do wonder whether it was a misunderstood description. I have often thought that perhaps it was a way to describe his playing; perhaps he was performing in a smooth and silky fashion. Perhaps from a distance his strings look as if they were strands of silk shining under the stage light rather than being actually made of silk or perhaps the magic of Bottesini's playing weaved a tapestry of silky sound from his strings; I can only think of something of this manner. As the source is unreferenced and repeatedly not provided when asked for, we cannot check the original item to understand its context.

Another possible thought is that it could have been a simple translation error where perhaps a simple innocent misunderstanding has snowballed into this big project. Unfortunately until the source is found we will never know.

Silk strings: string of the future?

Now, perhaps after reading what has preceded this, you might be wondering why I would be suggesting this material as a string of the future. Sometimes old practices get unintentionally forgotten despite perhaps having some answers to solving some modern issues. A problem with our strings today is that they are not widely recycled and do not biodegrade if thrown away. This is often caused by difficulty in processing the mixture of metals and synthetic materials in their construction alongside the item being small. This might not seem much of an issue for one set, but when scaled up to millions of strings across the world being replaced at least every few months, and combined with shipping, this amounts to quite a bit of stress on the planet's materials.

Looking to the future, we need to, in any possible way we can, reduce our impact on the planet, particularly in the case of disposable items. If there is a better way to produce more sustainable strings then it is our responsibility to do so. Throughout my research it has been very clear that silk works very well as a core and has been used on many instruments in centuries past. So with this material being used before, why has silk not been reinvestigated as an alternative?

Manufacturing practices have improved lately and I would like to encourage research into reusing this material again due to its biodegradable and natural properties. Silk is readily

available as a material, and if it can be made in a sustainable way, the only thing left is to find a sustainable working coating. Energy savings in its manufacture must also be considered; it takes much less energy to melt and process into a working string. Similarly, it would take far less time and resources to recycle a silk string compared to that of steel or synthetics. Modern strings need time and energy spent separating them into their core materials, either leaving the synthetic cores in landfill, or more energy to rework the metal into a new string. All of these factors combined make a large carbon footprint for simply recycling the material when there would be no carbon for a string that biodegrades in normal waste or compost. String recycling is not commonplace today anyway, and so if a string could be disposed of that didn't waste raw materials or put non-biodegradable materials in the earth, it would make a considerable difference over the course of the whole planet.

There must be a way to improve on the construction of the past making it ready for the playing requirements of today; however the big stumbling block is the wrapping/covering or glues used in their construction that both meets the needs of the bow and of sustainability. A tall order I know, however I try and encourage any efforts made in this direction and would love to know if people have any projects that are taking steps towards this.

Final Summary: Never say never

This has been a long project bringing much information together, involving much reading, and researching as much as I could to try and give strength to the statement that Bottesini used silk strings, but having searched relentlessly for the source of Rodney Slatford's claim, I simply cannot find it. After finding the account in *Bottesini A Napoli* (*47*) and after seeing the difficulties that arise from trying silk, I simply cannot find justification in the idea of Bottesini using silk strings.

A point to consider is that regardless of the material of the string, the equipment (or string for that matter) must match, or perhaps surpass the requirements of the music, or it wouldn't have been possible for Bottesini to consider writing his pieces with such techniques in the first place.

Bottesini had a unique relationship between his compositions and his instrument, having inside knowledge of how the instrument works and what it was capable of. Bottesini's compositions for double bass are this interplay between having studied composition formerly at Milan Conservatorio, growing up learning violin and its techniques and also pioneering on the double bass to push bass boundaries. These elements combined lead to Bottesini experimenting and finding new ways to write for the capabilities of the double bass, writing in a way that is idiomatic for the instrument with the equipment he had of that time. Although I do not dispute that I would play differently from Bottesini, a couple of colleagues have suggested to me that "you may have to change your technique to make the string work". With a plain silk string presenting more difficulties than gut, it seemed to me it would be illogical to try and change the music, my technique, or to use bowing styles from other periods of music to fit the limitations of the silk string when it could be achieved far more easily on gut. It also makes me wonder why Bottesini would choose a string that makes his already challenging pieces even more difficult to perform and why he would choose a string that performs worse than the most readily available string of his time.

The difficulties discovered in this research perhaps provide an explanation as to why silk had not become commonplace on bowed instruments in the music that came before Bottesini, despite silk being known as a string for thousands of years. Composers knew the capabilities of the instruments they were writing for and perhaps bass lines would be very different if silk was the predominant string used. Bottesini's experiences of starting first on the violin clearly influenced his writing as he brought many 'violinistic' techniques to the bass and so the equipment he used must have been physically capable of providing all of his expression and techniques.

On this note however, I would be very happy to be proved wrong. For me this would only add to the incredible story of Bottesini's life. The idea is for this whole article to be a starting point for others' research, for others to form their own opinions, and as an encouragement to look towards more sustainable practices in the future. I have presented many of my own opinions in this article and should say, to quote Bottesini himself, "*I hasten to forewarn those who might accuse me of a certain exclusiveness, more apparent than real, that I have every respect for the opinion of others, whilst I frankly state my own."* (*2*). However, I welcome differences of opinion as an opportunity to learn from, as it will only create more resources for others in the future.

I am very grateful for Maestro Korneel's research, Lawrence Kaster in his knowledge of strings, Enrica Donisi and of any of the other resources I have stumbled upon in my bibliography. The videos I have recorded to accompany this article can be found on my YouTube channel *Stephen Street Bass - https://www.youtube.com/user/stephenstreetbass*.

In the grand scheme of things, this is only a little dip into the ocean of this vast topic area with so many different connecting facets to it, but I hope it might be of use to someone and encourages others in the future.

Stephen Street

A catalogue of quotes from referenced articles

In an attempt to help others source information more quickly, I have compiled quotes from my research which have influenced my opinion and findings. As you can tell by the weighting of the quotes, it has been very difficult to find much written specifically on the double bass and particularly in Bottesini's time.

Quotes relating directly to the double bass

'M. Bottesini simply uses the classical three-string double bass, the third string not being spun, as they say in the term 'delutherie'...' (*13*)

'The five string tuning with mostly 34rd flourished mainly in Vienna, and was the type used by Mozart and Haydn. Late in the century, a three-string violone arose and became prominent in the 19th century, when the two leading virtuosos (Dragonetti and Bottesini) used it. Tunings usually were G1-D-A (called French) or A1-D-G (called 'Italian'). It used the ordinary sized instrument and octave transposition to play in a most constricted range. One advantage was to be able to dig into the notes without touching other strings while bowing not necessarily close to the bridge. Another advantage was of not needing any

metal-wound string, so consistently provided the fundamental rich foundation note for an orchestra that a thick all-gut string provides.' (*49*)

'In addition to the fact that music itself seems to have had little call for a doubling bass prior to the second half of the 17th century, Stephen Bonta has provided good evidence for why the major change in G violone use may have taken place. Wound strings were invented during the 1660's and may not even have been adopted in some regions until many years later. During the period that players used only pure gut strings, the "larger bodied" basses probably sounded better than their small bodied counterparts, when playing on their rope-like bottom strings.' (*50*)

'The violone or contrabass normally has five thick strings, also of sheep's gut…' (*30*)

Their two upper strings were made of pure sheep's gut, but the third, bottom string, was covered, reportedly in order to obtain a fuller tone (*30*).

Stringing of the violin family in the early nineteenth-century Germany (Frohlich, 1810-11). D = diameter, n° = gauge number of Fig. 7, mm= millimetre conversion taken in scale on the same gauge (Fig. 7(top), below). For the D string of the double bass Frohlich recommends thin wire for the covering, to assist the bow to grip the string. (*4*)

'…Italian bass players Luigi Rossi (Bottesini's master) and G. Anglois solved this difficulty when they invented a copper string-gauge for the double bass made after the example set by the German violinist-composer Louis Spohr…' (*30*)

This was actually the case, as the Italian and the English then used un-wound sheep's gut for all three of their strings, which they tuned in fourths, A d g. (*30*)

Thick all-gut basses were preferred to metal-wound basses on double basses in the 19th Century. Relevant here is what Quantz" wrote with respect to low-pitched large double basses: 'what is lost in clarity is made up in gravity'. Twentieth-century aesthetics puts clarity above all, and modern double bassists want as much richness and focus as they can get from their metal-wound strings. This illustrates how judgement of what constitutes good bass sound does change with the fashion of the time. (*18*)

Data about double bass stringing is even rarer than for its smaller relatives.
Before the nineteenth century we know only that at Naples, in 1765-66, the lowest string comprised 120 guts.119 for subsequent periods, see Table 12. For a double bass tuned by fifths (G-D-A), the diameter of the A provided by Delezenne in 1853
(3.8 mm) gives a fairly robust string.12° In contrast, weaker stringing was adopted by two English luthiers at the end of the century. They employed plain gut only (even for the G) and a scaling of tensions close to what Plassiard considers ideal
(Table 12). In Italy, tuning by fourths was customary: (E-)A-D-G, initially limited to the three high strings, as at Naples in 1834 [C]. Giuseppe Baldantoni (1784-1873) is deemed the first to introduce overspun strings on the Italian double bass. As with the violoncello, string diameters decreased progressively during the twentieth century (Table 12). (*4*)

The author refers to the new overspun bass strings; however he gives the impression he is talking about a new technological strategy for loading gut (i.e. the use of metal wire) in place of a more traditional one. (*51*)

'CATLINES ARE HERE, and at last we can experience the true gut bass sound of the late Renaissance, Baroque and early Classical periods. Variants of the word "catline" are "catlin" and "catling". The earliest instance of its use that we know of is in a 1568 import document. As quoted below, by Mace's time, the word was mainly used for middle-range strings of recognizably identical structure to the thick bass strings, which by then had acquired different names. By the 19th century, it meant thin strings. When all-gut stringing was used in the 18th and 19th centuries, we believe that the thick bass strings were just like those earlier ones called Catlines, since we know of no other way of making an all-gut thick string that will successfully compete with overspun strings in musical effectiveness. The information available indicates that all-gut bass strings were used on:
-All gut-strung instruments before about 1660
-All gut-strung English instruments before about 1700
-Italian violins and violas well into the 18th century
-Some German violins in the 18th century 5 and 19th century
-Some Double Basses till the beginning of the 20th century
The information available indicates that overspun bass strings were used on: -Violoncellos in Italy and France after about 1660 8 -Bass viols in France after about 1660
-Violins in France after about 1700
-Some German violins in the 18th century
-Most violins in the 19th century' (*52*)

J.Stainer "Stainer and Barretts Dictionary of Musical Terms" New and revised edition (1898) p.418. In the entry under "String" is stated: "the double bass strings are of thick gut uncovered". (*52*)

'As the guts, in their natural state, are not sufficiently uniform in diameter to obtain that cylindricity and parallelness that is the great aim of the string-maker, they often require to be split into long threads by means of a knife specially prepared for the purpose, which threads are then placed in a jar with their thick and thin ends set alternately. The next operation is the spinning, which is performed on a frame about three times as long as a fiddle. It is done as follows: two, three, or more fibres (according to the string required to be made) are taken and set alternately; that is, the thick end of one opposite the thin end of another. The usual number apportioned to the four strings of a violin are as Follows: for the first, or E string, 3-4 fine threads; for the second, or A, 3-4 strong ones; for the third, or D, 6-7 strong ones. Beyond this, double bass strings reach as many as 85 fibres, but this is a branch of the manufacture which does not concern us.' (*12*)

The fourth era was that of metal-overspun (gut) strings. He quotes from the "Ephemerides" manuscript by Samuel Hartlib, dated 1659, the first evidence of such strings: "Goretsky hath an invention of lute strings covered with silver wyer, or strings which make a most admirable musick. Mr. Boyle. [...] Strings of guts done about with silver wyer makes a very sweet musick, being of Goretsky's invention". This antedates by a few years the well-known playford advertisement in An Introduction to the Skill of Musick (1664).

The Statement that, as a result of the availability of overspun strings, 'the instrument makers systematically shortened the vibrating lengths of the da fondamento instruments so as to make them more manageable', is contrary to the evidence except for the bass viol. The earlier larger bass viol used an overspun 6th in Germany to become a small vioibne. The Violoncello grew in popularity, often replacing the violone, but neither seriously

changed its vibrating length. The normal violone (of the size of the modern double bass), and the considerably larger contrabasso violone continued, sometimes (and only sometimes) using an overspun 6th for a I lower tuning. In the 19th Century, the 4-string violone/double bass had an overspun EE, but the very popular 3-string double bass (played by Bottesini and Dragonetti) used no overspun strings. (*29*)

Information on silk strings used (or not used) by different instruments

Cello

'Metal-covered C and G strings on the cello were normal in the late eighteenth century, as was a metal-covered G on the violin; the remaining strings of both instruments were almost
Invariably made of pure gut until the early twentieth century (though various other materials, including silk and metal, were tried without their gaining general acceptance in the nineteenth century.' (*53*)

It should be noted that in Rome and Naples only 'silver' (argento) is mention for overspinning the gut or silk strings. At Florence the use of overspun strings, both on the violin and violoncello, seems to be indicated as early as about 1685 in paintings by Antonio Domenico Gabbiani that show musicians at the Medici court. (*4*)

Eastern instruments

'The most original instrument among the Oroans is called the "toro-toro"; it is made of clay, pyramidal in shape, and hollow inside. It is blown from the larger end, and is used by boys and girls in one of their special dances. Their main "strings" are two banjo-like instruments fashioned from gourds, with silk or cotton strings' (*54*)

'5/5 is a folk song quite popular in Kucha County where the music's character is different from that of both Kashgar and Ilin. In this selection, we can see the dutar, the most popular instrument in Xinjiang, which employs two silk strings and gives a soft sound to accompany the singer. Uygurs like it more than Westerners like the
Guitar.' (*55*)

'Early Chinese zither makers had a sophisticated under- standing of these variables, as demonstrated in their calculation of the diameters of silk strings and, especially, in their use of moveable bridges to control vibrating length.' (*56*)

'There can be no doubt that the strings of ancient instruments were of Gut [or silk] as on the Turkish Qopuz' (*57*)

'..xiao (vertical flute; pronounced "SHaHW"), and Jiangnan Sizhu (a silk and bamboo instrumental ensemble; pronounced "jee-AHNG-nahn SEE-joo"). (*58*)

'... the dutor, a long-necked, fretted lute with two silk strings that are plucked with the fingers; the tanbur, long-necked, frette lute with four or five metal strings that are plucked with a noxun...' (*59*)

'The robāb is fitted with six silk strings, which are made of the kinds. The first kind is zīr, which is the thickest string. The second kind is hād, which is a thinner string in comparission with zīr. The third is matnā, which is a thinner string in comparison with the hād string.' (*60*)

Lute

'The present examination of the lute will be limited to the period between the early i6th century and the second half of the 18th century, comprising the span of time between the earliest lute surviving and the latest instruments made for non-historical playing purposes. All lutes of this period have in common a number of features, listed already by Curt Sachs in 1913.1 they are:
Vaulted back, consisting of several ribs; flat soundboard with one or more roses;
Separate neck with movable frets;
Bent-back head with lateral pegs;
Double strings to each course with possible exception of the first or the first two courses;
Strings fixed to a bridge; gut or silk serving as material for strings. ' (*14*) (*15*)

Those who have tried gut strings on the upper registers of their lutes recognise the superior tone over nylon, but find the trouble of keeping the gut strings in tune a serious barrier. - spun bass strings are universally used even though they are widely recognised as unauthentic on instruments before at least the last quarter of the I7th century. (*15*)

The fourth era. The last era - which still continues today - is marked by the advent of overspun bass strings consisting of a gut core (i.e. an ordinary plain gut string) over which is wound a fine metallic wire; the windings can be either close or open. The oldest extant document attesting this technique dates from 1659: "Goretsky hath an invention of lute strings covered with silver wyer, or strings which make a most admirable musick. Mr Boyle. [...] String of guts done about with silver wyer makes a very sweet musick, being of Goretsky's invention". This is closely followed by John Playford's viol treatise of 1664 and other works. However, the spread of these more efficient basses was not as rapid as one might imagine: the viol player Sainte-Colombe introduced them to France only around 1675, and in Italy, a country renowned for its string production, the earliest evidence is from the year 1677. The earliest extant iconographic evidence of a violin with a white fourth string (probably overspun with silver) can be dated to the mid 168os. (*16*)

Modern bass strings of the lute (that is from the 6th course on) are made of metal overspun on silk. Such a method is however only mentioned starting 1668. (*17*)

Guitar

'So that you won't stay up nights wondering: silk and steel strings came in a close second to light gauge bronze. The emphasis on playing techniques is a nice complement to the traditional stories: for example, the article on the Carter family clearly points out the major impact Mother Maybell had on all of us who are still playing guitar in the folk idiom today.' (*19*)

Before WWII (nylon was invented in 1939), the only options for treble strings were gut, silk and metal. (*18*)

'There is of course, a large body of music for the Baroque guitar, but its stringing, construction and technique completely separate it from the 'classical' six-string instrument. By the early 19th century, the guitar looked very like the modern instrument but was somewhat smaller and lighter and was strung with gut or overwound silk strings.' (*20*)

'Frets were slowly accepted in the 1870s and 1880s; strings continued to be made of gut (occasionally silk for the humid summer months). By the end of the century, the pitch of the instrument had risen a minor third, from A to C. The actual sound of a high-quality banjo of the 1890s was remarkably different from that of an 1840s banjo.' (*21*)

'At the same time the five-course Gut-strung guitar has lost its popularity in Britain in favour of the 'guitar', a six-course instrument with metal strings. By offering a 'short history of string-making', Sparks prepares the ground for the six-course guitar's growing popularity during the 1770's since the invention of strings made of (metal wound) silk instead of gut allowed the instrument to stay in tune much better; and the increasingly fashionable style of arpeggiated accompaniments to songs required strong, clear bass notes.' (*61*)

With the invention of nylon, the guitarists quickly replaced their bass strings wound on silk by strings wound on nylon floss, which lasted very much longer. (*18*)

'By that time, over-spun strings with metal over a core of silk were becoming generally available. Such strings had been known to the Chinese since the eighth century AD, while strings of silk, presumably without a covering, can be traced in Europe as early as the 1300s. 10 Nonetheless, the first secure European reference to over-spun silk does not appear until 1762 in Michel Corrette's guitar method, Les dons d' Apollon, where they are described as being 'à la maniere des Chinois'. Sixteen years later, in 1778, the owner of a silk mill in Kent, Peter Nouaille, an entrepreneur of Huguenot stock, was granted Letters Patent 'for the sole using, exercising and vending, new invented Silk Strings, for all sorts of stringed musical instruments'.11 It was no doubt a matter of opinion then, as it still is now, whether these 'new invented' silk strings yielded a more acceptable result at lower pitches than the gut hitherto used for bourdons; what is certain is that they gave further impetus to a re-envisioning of the guitar during the third quarter of the eighteenth century by commending them- selves to many players as the means to create an enhanced bass response by the addition of a sixth string.' (*22*)

Violin/viols

'There is a late invention of Strings for the Basses of Viols and Violins, or Lutes, which sound much better and lowder then the common Gut Strings, either under the Bow or Finger. It is Small Wire twisted or gimp'd upon a gut string or upon Silk. I have made tryal of both, but those upon Silk do hold best and give as good a sound...' (*27*)

'Whatever their fluctuating size, though, bass-violins were fitted with crude, primitive, solid gut strings that necessitated great sounding lengths. The common, or ordinary orchestral bass-violins were intended as regular constituents of the instrumental ensemble.' (*30*)

'Not before late in the 16th century (when more elastic bass strings became available) did any viol tuning go below C. During the 16th century the sizes in many viol sets (all in

England and France, and many in Italy and Germany) became about 20 per cent smaller. The smaller viols were then called just viole or viole da gamba, while the original bass size kept the old name violone.' (*49*)

...bass strings, consisting of a gut core wrapped with fine metal wire (generally of silver but also of copper and brass). These new strings, a genuinely revolutionary discovery, appeared towards the second half of the seventeenth century, spread rapidly and were directly responsible for the swift abandonment of the awkward bass violins in use until the end of the seventeenth century (or shortly after) in favour of the emerging violoncello. (*16*)

I am no string maker but, as I understand it, the roped gut bass strings manufactured today and called catlines are made the same way as a multi-strand rope, the individual strands being bundles of fibres that are twisted before being wound together as a rope - the resulting assembly of twisted strands being stable with no tendency to unwind. Ramelli's observation, if the English translation is true to the original text, implies that the thick gut strings of bass viols were made up from the equivalent of four modern catlines simply twisted together to form a complex rope, which I imagine presents no problem to manufacture today if a little costly.
On the other hand, Ramelli's statement may mean that the ropes of the machine were made in the same way as the strings of a viol i.e. from gut and constructed like a rope.
Whichever way is chosen to interpret this passage, I believe that it is positive evidence confirming roped string construction was being used, at least on viols, before the end of the 16th C. Historical information describing string construction from this period is sparse and ambiguous and I do not recall having read about any references until now that clearly support the proposition that roped gut strings were in use during the Renaissance in Europe. (*62*)

Acribelle Silk Violin Strings - Although considered by some to be inferior in tone and durability to gut strings made from animal intestines, Acribelle silk violin E and A strings enjoyed popularity in the West for more than three decades from the late 19th C until the 1920's. This type of string was manufactured from silk filament made homogeneous – like the Japanese 'silkworm gut' - with some kind of flexible binder. Advertised as 'Acribelle'- presumably a generic term for similar strings made by a number of different manufacturers? According to Franz Jahnel ' Die Guitarre und ihr Bau', 1963 these strings were manufactured in Vogtland and Schönbach, Bohemia using processes that dissolved the outer surfaces of the layers of silk filaments to obtain a smooth and shining lustre. However, other manufacturing procedures were also used to make smooth transparent strings of this type – unknown processes because they were never patented. (*28*)

Few changes were made in the structure of the violin family instruments until the early years of the nineteenth century, when there was increased demand for still greater power. The neck of the violin was lengthened and its bass-bar appropriately stiffened to permit an increase in string length and string tension. The commonly used gut and silk strings were eventually replaced by gut strings wound with wire and sometimes by all metal strings. (*63*)

Silk strings were introduced in France about 1803, thanks to a process invented by Baud. As a result of its approval by Francois-Joseph Gossec, it saw a certain popularity during that century, also as a version known as 'Acribelle', without ever managing to enter into 'common use'. Their manufacture in Venice started about1830, apparently employing

original techniques devised by the 'mechanician' Locatelli. Barberi and Beretta's musical dictionary (1869) states that those produced in Italy 'need not envy the French ones and may, by chance, even be better'. (*4*)

'There is a late invention of Strings for the Basses of Viols and Violins, or Lutes, which sound much better and lowder then the common Gut Strings, either under the Bow or Finger. It is a Small Wire twisted or gimp'd upon a gut string or upon Silk...." (*52*)

For bowed instruments, silk is mentioned in Italy as early as 1640, by Giambattista Doni. In order to differentiate the timbre of two of the pseudo-Greek modes he intended to reintroduce into musical practice, this author proposed to employ gut for the 'more brilliant' of the two and to 'adapt the other with strings of twisted raw silk, which, finished in a certain way that we have discovered, provide an excellent sound'. (*4*)

All violin players are familiar with the now-common Acribelle, or silk, strings, which are composed of an infinity of filaments of silk, so twisted together and polished as to exceed in uniformity and transparency the finest gut strings. For players troubled with perspiring hands, and for hot or damp climates, they are, without doubt, invaluable, for they are but little affected by damp, and they make up in convenience in these respects what they certainly lack in tone. They are apt also to fray and get ragged, and though it has been recommended when this is the case to draw the string quickly through the flame of a spirit lamp, to remove the frayed fibres, an Acribelle string once gone wrong, is ghastly with a ghastliness more easily imagined than described. The same remark applies to the twisted or plaited strings, sometimes known as Chinese water-cord. These are quite the best for players with hot hands, and are almost exclusively used by violinists in India and other hot countries, where the ordinary strings not only break very easily, but also are very difficult to keep. But, of course, their tone is inferior to gut. (*12*)

For violins it is generally gut which is covered with copper (plated or pure), or with silver. Silk is also used, but it is difficult to tune accurately, and will not remain in tune when once screwed up; undoubtedly the best are the copper-plated gut ones. I always obtain m y covered strings for violin or viola from Mr. G. Hart, who covers them with alternate spirals of gunmetal and plated copper. The best (recommended by Herr Strauss) are wrapped over close to the knot with red silk. The gut of which covered strings are formed is not sulphured, nor is it oiled. (*12*)

During the sixteenth century the main centres of string making were also important for the dyeing and spinning of silk and cotton: Florence, Venice, Nuremberg and Lyon. It is plausible, therefore, that the string makers learned from the more complex techniques used in the spinning of silk: processes that would have allowed a significant initial reduction of the stiffness of the thicker strings used in the bass register. In fact, we may deduce that bass strings were even more elastic and efficient than before if instrument makers were able to permit themselves important structural developments: in the case of the lute, a sixth course was added some time towards the end of the fifteenth century, thus extending the instrument's range by as much as a fourth (sometimes a fifth) below the fifth course; the same happened to the bowed viol. (*16*)

With the introduction of overspun strings (and with the consequent increase in demand for them, especially from bowed instruments), the ancient, secret techniques of making all-gut bass strings declined rapidly and were soon forgotten by the new generation of string

makers: just by wrapping a thin metal wire around a gut string one got a much larger sound. (*16*)

As mentioned earlier, in the eighteenth and nineteenth centuries the violin G-string - Galeazzi's "cordone" - was always overspun. In the eighteenth century, and much of the next century, it had a gut-core (or a silk-core, as we learn from Heron-Allen), round which was closely wrapped metal wire, generally of silver, but also of copper or silver-plated copper. (*16*)

At this period the viol had but six strings, but towards the end of the seventeenth century, a seventh was added? The French gamba -player, Marais, added three bass strings of covered gut, but it was an innovation, which did not in any way become general. (*12*)

'...simultaneously they enable us to obtain the maximum acoustic performance from a bass gut string: was this the case for the violone basses of Ramelli's time?' (*64*)

'Edward (Dodd) exhibited his violin, violoncello, double bass and harp strings: his promotional material indicated that almost a century after Laroach's letter to the Royal Society, there was still a desire to at least match and hopefully to improve on the imported Italian strings.' (*65*)

The Clavi-harp

'The Clavi-harp is a new musical instrument invented by Mr. Dietz, of Brussels. Several attempts have been made before by inventors to produce the peculiarities of the harp tone by means of a keyboard like that of a pianoforte attached to a harp, not one had superseded the original instrument whose quality of sound was sought to be produced. Mr Dietz has conquered this difficulty by the use of wire-strings covered with silk; the instrument is, therefore, no more likely to get out of tune than the ordinary pianoforte.' (*66*)

Lyre

'The materials on which Apollo's play depended were scarcely less grisly than its consequences. Despite Roger North's decorous belief that the lyre's strings must have been "mettaline . . . or of twisted silk," since only barbarians would have been so "rude and gross" as to handle "gutts and garbages," countless sheep, tortoises, and oxen died alongside Marsyas for its sake.' (*67*)

Harp

Citizen Baud, inventor of a method for manufacturing silk strings for musical instruments . . . requests that the Class investigate the set of harp strings he is presenting, with a view to his obtaining a patent. In a letter accompanying the proposal, 4 Baud traces the development of his method. He writes of having undertaken the fabrication of silk strings some two years earlier, and after six months, of producing his first examples for the harpist, Gelinek of Versailles. (*23*)

In it, Gossec writes of having sought the opinion of colleagues at the Conservatoire de Musique concerning the strings and of having strung a harp with them for a practical demonstration of their sound. All were convinced, he notes, that for plucked stringed

instruments, the silk strings had as good a quality of sound as those of gut, while being more durable and better able to withstand higher tension. He adds, however, that the same did not hold true for bowed stringed instruments. Gossec argues that, because of their method of manufacture, silk strings conserve a grainy texture not characteristic of gut. This texture tends to separate the bow hairs when the strings are played upon, especially in sustained sounds, resulting in loss of resonance. Also, the texture makes the silk strings susceptible to being lacerated through friction created with the bow hairs. (*23*)

Appended too is a copy of a letter from Gossec to Baud, dated 31 July 1802 (12 Thermidor An X), in which the academician congratulates the inventor for his achievement in producing new samples of silk strings for the violin that greatly attenuate the one fault he had found with prior samples: grainy texture.
Notwithstanding Gossec's encouragement, Baud's strings seem never to have been adopted for general use. Indeed, owing to the physical nature of silk, it is doubtful whether Baud could ever have completely eliminated the problem identified by Gossec. (*23*)

In spite of these properties, problems encountered in the fabrication of strings made from silk are commonly referred to in the literature.'2 Owing to their elasticity, silk strings tend to stretch easily and keeping them in tune is said to be often difficult. Nineteenth-century string makers developed a technique of pre-stretching silk strings to avoid this problem; it may well be that I8Sth-century makers also pre- stretched their strings, since commentators of the time specifically stress their ability to stay in tune. More problematical, however, is the texture of the silk strings (as recognized by Gossec). Silk fibers must be twisted when formed into strings because of two dominant characteristics: the resistance of individual fibers to conform with each other when combined into a thread, and their high elasticity. Unless the strings are tightly twisted, impregnated, firmly knotted and secured at both ends, they will tend to unravel. Further, in twisting strands of silk together to form a string, individual fibers are known to break and protrude from the string surface, causing a rough texture. 'They are also apt to fray and get ragged' through use.13 In addition, since a rope-making technology is widely used in forming twisted strings-that is, fibers are twisted together to form threads, which in turn, are twisted together to form bundles of threads, etc.-the resulting string surface is undulating and irregular, strongly resembling that of cord or twine. On bowed instruments, the texture of silk strings is said to lead to a sound that is shrill, suitable especially to open-air musicians. While techniques for dealing with these problems have been developed, they have never been entirely successful. (*23*)*Except for the chanterelle, all the strings are intended for use on a harp. The numbering defines an instrument of 38 strings, tuned from contra-G' to b''', of which the lowest ten are constructed of wire wound over a silk core, and the others of bundles of twisted silk with no overwinding.* (*23*)

The principal difference in construction between the harp strings and the chanterelle is that the violin string is comprised, not of a series of bundles of a standard thread, but of only one large bundle of individual silk strands (much like the core of the wire-wound strings) twisted together and impregnated. (*23*)

Wire-wound strings on a silk core were not new with Baud; they were already being produced in 17th-century Europe. (*24*)

Overwound strings on a silk core continued to be used, principally for harp and guitar, until the early 20th century. (*25*)

Albert Cohen about a complete set of silk and overwrapped silk strings from 1798 for the harp gives valuable information on strings, which were designed specifically for harps of that, might have been used on harps of that age. (*26*)

Cohen's report gives the diameters of the simple silk string wrap and core diameters of the bass overwrapped silk string used at the end of the eighteenth century. (*26*)

Although the professional opinion reported to the Academy was that the silk strings had a good quality of sound it is unlikely that the design for silk strings was ever adopted for general use by harpists. (*26*)

In the silk strings rope making techniques were used in their construction but produced a grainy texture and an undulating surface resembling rope or twine, and the way in which individual fibres resisted conforming to one another resulted in a strong tendency to unravel. (*26*)

In order to maintain the tonal quality of the strings, and in order to maintain the required tension, a break occurs in the stringing and overwrapped strings are used in the bass register. In the cache of silk strings the diameter of the silk core is reduced overwrapped with silvered-copper. (*26*)

Evidence of silk strings or products being made (general):

'The whole framework of the Society was that of a trade guild. We know from general history that the Spitalfields silk weavers, although employed in a depressed trade, were an intelligent and well organised community, for in 1773 they were able to wrest from Parliament an Act to regulate their wages.' (*37*)

Appendix 4 deals with string materials in the Middle Ages, with references to gut ones in Latin, Middle French, Old High German, Middle High German and Middle English; to metallic strings in Latin, Middle French, Spanish, Middle English and Middle Dutch; to silk strings in Latin and Middle High German, and to horsehair strings in Latin. (*38*)

The silk strings without metal overwind are more unusual in construction. (*68*)

'On 9 October 1798, an inventor from Versailles named Baud,' who was seeking patent approval for a new method of constructing musical strings out of twisted silk, submitted samples of those strings to the scientific academy in Paris. The academy was requested, not to examine the strings, but rather to seal them within the cane box in which they were presented, retaining them for review at a later time (Pls. IV, V).' (*23*)

All were convinced, he notes, that for plucked stringed instruments, the silk strings had as good a quality of sound as those of gut, while being more durable and better able to withstand higher tension. He adds, however, that the same did not hold true for bowed stringed instruments. Gossec argues that, because of their method of manufacture, silk strings conserve a grainy texture not characteristic of gut. This texture tends to separate the bow hairs when the strings are played upon, especially in sustained sounds, resulting in loss of resonance. Also, the texture makes the silk strings susceptible to being lacerated through friction created with the bow hairs. (*23*)

On the 9th October 1798, an inventor from Versailles named Baud,' who was seeking patent approval for a new method of constructing musical strings out of twisted silk, submitted samples of those strings to the scientific academy in Paris (*23*)

'Stowell gives an interesting summary of the strings used or recommended by various famous violinists such as Paganini and Spohr. He discusses the use of silk and overwinding, but indicates that at least the A and E strings were usually made entirely of gut until the early twentieth century.'

The French rank third. Their larger strings are better than their seconds, which are often brittle; their patent first accribelles, made of silk, are hard and brilliant, but not comparable, in my opinion, to a fine Roman gut " E " string. (*65*)

It is interesting that the 16th author of the recipe for making these strings compared them in appearance to silk strings - not only because it implies that silk instrument strings were in use in Europe at that time but because it suggests that sinew strings, like silk strings, were distinct in appearance from other instrument strings. (*69*)

Although a thriving area in the late eighteenth century where silk workers based, by the middle of the nineteenth century Spitalfields had become an area of deprivation. (*65*)

Silk strings are made from a bundle of individual filaments or threads twisted and glued together to form a uniform cylindrical string. Twisting a bundle of filaments results in a shortening of the original untwisted length and a consequent increase in the diameter (the volume remaining unchanged) – the greater the degree of twist, the greater the diameter increase of the completed string. Twisting the filaments also reduces the tensile strength of a string. For maximum tensile strength the silk filament bundle making up the top string should have minimal twist. Information about silk instrument strings is limited but based upon a few preliminary trials, a simply twisted silk filament bundle will increase in diameter by about 7%, minimum twist and by about 18% to 22%, maximum twist (see Fig.3) The ancient Chinese made their silk instrument strings as either three or four strand roped construction resulting in an increased diameter of about 29 % in the fully twisted state (calculated from a reduction in length of 40% of a fully twisted roped string - as recorded in the early Chinese texts on string making). (*39*)

The material might just possibly be 'acribelle' which I believe was a silk string impregnated with glue to stiffen it. (see Goodwin's article In March 2003 EMP below). But because I've never seen such silk strings I don't actually know if this is the case here. (*70*)

The commonest strings for all European bowed and plucked instruments have always been made from sheep's' guts, right from ancient times until the take-over by metal strings in the second half of the present century. Some sources specify ram's gut and two further sources specify the gut of the whether (a castrated ram). Other materials were occasionally used and they included metals, silk, leather, horsehair, sinews and guts of other animals. The only reference to gut from a cat before Shakespearean times concerns the Arab minstrel Ziryab who reputedly made his strings from the intestines of young lions. A 14th century Middle English text mentions wolf-gut strings. Arab musicians in the Middle Ages often favoured silk strings, or some silk and some gut on their instruments. The silk threads were twisted into a strand then rubbed with a viscous gum tinted with saffron, a method very

similar to a modern one (A. Eachmann 1925) which uses gum arabic to bind the fibres. Silk strings are noted for their taning stability and for keeping their strength in hot or humid conditions. We find that their bowed tone is pure and bright, though a little thin, compared with gut strings. (*40*)

Mais l'exposition française conserve à cet égard toute son importance. Outre MM. Savaresse père et fils (Exp., no 9606 et 9607), nous remarquons les cordes dites acribelles, qui ont la prétention de remplacer avec avantage les cordes de Naples et les cordes de soie. Cet avec avantage me parait de trop pour ceux qui sont au courant des choses. Elles sont, dit-on, fabriquées par des procédés mécaniques et chimiques d'une grande perfectionet toutes identiques. Elles ont encore une infinité d'autres qualités (du moins dans le prospeclus qui se distribute), et surtout celle de pouvoir monter de trois tons sans rompre. Je dois ajouter que plusieurs violonistes de Paris, en tête desquels setrouvent MM.Alard, Girard, Maurin, ont attesté la bonté de ces cordes. Cependant, ils disent tous quils les ont essayées,mais non qu'ils les ont adoptées. Peut•être attendent-ils. J'en fais autant. (71)

Translating as:

But the French exhibition retains all its importance in this respect. In addition to Messrs Savaresse père et fils (Exp., no. 9606 and 9607), we note the so-called acribelle ropes, which claim to replace with advantage the Naples and silk ropes. This advantage seems to me to be too much for those who are aware of the things. They are said to be manufactured by mechanical and chemical processes of great perfection and all identical. They have an infinite number of other qualities (at least in the case of the prospectus that is being distributed), especially that of being able to go up three tones without breaking. I must add that several Paris violinists, led by Messrs Alard, Girard and Maurin, have attested to the goodness of these strings. However, they all say that they have tried them, but not that they have adopted them. Perhaps they are waiting. I do the same. (*71*)

Adverts for silk strings

'VIOLIN STRINGS to stand at Concert Pitch, five first (gut or silk) or two everlasting metallic strings free for thirteen stamps. Dean's Music Warehouse, 77, City Road London, E.C. Established 1848. Price Lists sent free.' (*72*)

Loading/wrapping Strings (general)

By adopting a small-diameter gut string and twisting around it a spiral of thin metal wire, so as to make it heavier without greatly affecting its stiffness. In 4.3 we shall see that this fourth solution was introduced in Rome as a substitute for the second: towards 1676 for the violone, and at least 70 years later for the violin. (*4*)

In 1618 Praetorius first mentions metal strings wrapped in parchment, used for the basses of the Geigenwerck. He does not state whether this was intended to improve the grip of the rotating bow or whether the function was the same as the silk-covered metal strings employed by Johann Christian Dietz in his claviarpa (1814-19): i.e. to produce a 'soft and harmonic' sound like the gut of a harp. There is no mention of gut strings weighted with metal winding until 1659. In Italy, in Rome to be precise, they appear in 1676, when silver-wound string was employed for a violone. (*4*)

The third advance was overspun or wound strings. The first mention of these that we know of was as an advertisement in the back of Playford's "Introduction to the Skill of Musick" (1664) stating: 'There is a late invention of Strings for the Basses of Viols and Violins, or Lutes, which sound much better and lowder than the common Gut strings, either under the Bow or Finger. It is a Small Wire twisted or gimp'd upon a gut string or upon Silk. I have made tryal of both, but those upon Silk do hold best and give as good a sound..." We know of no evidence for the widespread use of overspun strings in England before the 16th century (Talbot in 1690 mentioned only Venice Catlines), but the French in Lully's time were not long in embracing the invention. Jean Rousseau in 1687 reported that Sainte-Colombe, the viol da gamba virtuoso, introduced the seventh string to the gamba about 1675 at the same time that he introduced the use of strings spun with silver wire for the three lower strings. French paintings of that time show such strings on cellos. (*40*)

The earliest mention of wound strings that we know of was brought to our attention by Ian Harwood, in "An introduction to renaissance viols", Early Music, October 1974 p. 244. An advertisement in John Playford's "Introduction to the Skill of Musick" (1664) states: 'There is a late invention of Strings for the Basses of Viols and Violins, or Lutes, which sound much better and lowder then the common Gut Strings, either under the Bow or Finger. It is a Small Wire twisted or gimp'd upon a gut string or upon Silk...."

The advertisement for a new kind of string with metal wrapped around silk or gut, in the back of Playford's 1664 edition of "Introduction to the Skill of Musick" was first noticed in modera times by Bob Spencer who quoted it in a review in Musical Times (December 1970). It was then given further circulation by Ian Harwood in Early Music (October 1974). (*73*)

*The investigation about modern treatises on silk dyeing and salt loading (13)(14) was thus fundamental in order to isolate some specific processes used for this fibre (with an increase of two to three times the silk's weight after treatment) that could as well be employed on gut. It can be observed that some modern techniques employ processes and salt used in the 16th and 17th century for normal fabric and leather dyeing. The only limit was that the bath temperature could not exceed 45*C, or the gut could degenerate.*

'THE METHOD - Silk loading treatments are essentially based on the technique of letting a salt solution be first absorbed by and then fixed into the fibre, by means of suitable agents. The even absorption of the salts in the fibre is favoured by other substances. In the 16th century these substances were represented by gum Arabic, lemon juice, animal glue, soaps, etc. They will become very important for the obtention of really effective loading (15).
The dosage of these substances being merely experimental, this a particularly difficult field.' (*17*)

The covering of strings by low-density materials might have an early European historical precedent. Praetorius's wheel-bowed keyboard instrument the Geigenwerck had its heavier strings 'made from thick brass or steel, wound with fine parchment; the bottom ones are nearly as thick as those of the great bass viol, since some go down to bottom FF and DD'. It is not clear whether the parchment was along the full length of the string, or whether it was just near the 'bowing' position (perhaps performing a function similar to that of the cotton on a hurdy gurdy string). (*74*)

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